Volume 21, Number 24 December 31, 1967

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 45187, 45198, 45238, 45250, 45446–45448, 45864, 45990, 45991, 46928, and 47050.

45005 (ANL–7325, pp 201-3) ANALYTICAL RESEARCH AND DEVELOPMENT. Larsen, R. P.; Meyer, R. J. (Argonne National Lab., Ill.).

Developments are reported for studies on: total rare earths for monitoring burnup; and determination of fast fission yield of ^{141}Pr by neutron activation analysis. (P.C.H.)

45006 (BNWL–491) SAMPLING FFTF SODIUM COOLANT FOR ANALYTICAL PURPOSES. Scott, F. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1967. Contract AT(45-1)-1830. 33p. Dep. CFSTI.

The current state of the art of liquid-metal-coolant sampling was reviewed with particular emphasis on the sampling of highly radioactive streams in operating reactors and on the requirements of the FFTF (Fast Flux Test Facility) program. The advantages, disadvantages, available experience, and applicability to FFTF needs of each of the four most promising means of removing a small representative portion of the loop coolant (initial sampling) were compared. Similar comparisons were made for the techniques commonly used to obtain the actual analytical sample from this initial sample (secondary sampling). Based on these comparisons, a conceptual design for the FFTF sodium sampling system is described. It is based on the use of a bypass loop for the initial sampling phase and is versatile enough to permit the addition of the more complex dipping bucket-distillation sampler if development of this device proves that it can be successfully operated remotely with a high degree of reliability. Secondary sampling is accomplished by removal of a portion of the loop and subsequent sectioning. Backup and initial and secondary sampling techniques are considered. Additional information and experimental evaluation will be necessary in order to make a choice between candidate sampling operations and to permit the final design of the FFTF sampling system. The experimental program required to develop and test prototypical samplers is outlined. It entails the construction and remote operation of prototype samplers in nonradioactive environments, followed by the design, construction, and proof testing of prototypes on radioactive streams. A major design choice will have to be made between individual sampler locations for each test loop and sample point and a centralized location to which all samples are piped. This choice will have a major impact on reactor design and costs. (auth)

45007 (CNEA–186) APARATO PARA LA DETERMINACION DE GASES EN METALES POR FUSION EN VACIO. (Device for Determining Gas in Metals by Vacuum Fusion). Zuzek, Estanislao; Di Primio, Juan C. (Comision Nacionale de Energia Atomica, Buenos Aires (Argentina)). 1967. 44p. (In Spanish). Dep.

A device is described for the vacuum-fusion determination of gases using classical analytical techniques based on selective separation of the components of the gaseous mixture. The gases that can be determined are H_2, O_2, and N_2. The efficiency with respect to N_2 can only be considered to be semiquantitative. The efficiency of the device with respect to H_2 and O_2 was measured on a $Ta-H_2$ system. The results show that the H_2 can be extracted quantitatively. (J.S.R.)

45008 (GEAP–5020) SODIUM MASS TRANSFER. XXIV. METHODS FOR SEPARATION AND IDENTIFICATION OF SODIUM IMPURITIES. Dutina, D.; Simpson, J. L. (General Electric Co., Pleasanton, Calif. Nuclear Technology Dept.). Mar. 1967. Contract AT(04-3)-189. 29p. Dep. CFSTI.

During operation of the loops under Phase 1 of the Sodium Mass Transfer Project, sodium from the systems was analyzed frequently for carbon and metallic impurities. However, there was little direct correlation between the elemental species found and the extent of mass transfer. Neither was it possible by means of these analyses to identify material causing early flow reductions in plugging indicators. It was surmised that both phenomena may be related to compounds of the various elements in sodium. A program to separate, identify, and measure such compounds was initiated. The development and use of special equipment and procedures for efficient recovery and sensitive identification of impurities from loop sodium through January 1, 1967 is reported. The construction and installation of equipment for three sodium impurities separation methods (amalgamation, vacuum distillation, and liquid ammonia leaching), are described. The separation techniques were developed and the systems were operated to perform initial separations and analyses of impurities from sodium drained from a mass-transfer loop dump tank. Good recoveries of impurities such as iron, chromium, nickel, and calcium were demonstrated. Some of the chemical effects of the separations procedure on possible impurities were examined and the results presented. The development and testing of techniques to isolate and encapsulate the separated impurities without altering them is nearing completion. Sealed-glass capillaries and vacuum-tight filter sample holders enable examination of impurities by nondestructive analytical methods. An inert atmosphere box was installed to handle samples and to encapsulate separated residues. The development of analytical techniques centered primarily in the use of x-ray diffraction methods. A literature survey and an accumulation of patterns of possible impurity compounds was compiled. Equipment was modified to prevent atmospheric contamination during analysis. X-ray patterns of some impurities in dump tank sodium were identified. A study of the applicability of DTA-EGA (differential thermal analysis-effluent gas analysis) as a backup technique for characterization of the residue was initiated. Analysis of decomposition gases evolved during the amalgamation separation proved possible. Fabrication of a large sampling container to provide representative sodium from the program loops is underway. The distillation technique was selected for in-line impurity monitoring. Design work was initiated on a device to collect relatively large amounts of the material causing high-temperature (about 600°F) flow stoppage in mass transfer loop plugging indicators. (auth)

45009 (K-L–6163) DENSITY OF VOLATILE CORROSIVE LIQUIDS: METHOD AND EQUIPMENT. Hedge, W. D. (Oak Ridge Gaseous Diffusion Plant, Tenn.). [nd]. Contract W-7405-eng-26. 11p. (CONF-671012-1). Dep. CFSTI.

From 11th Conference on Analytical Chemistry in Nuclear Technology, Gatlinburg, Tenn.

Equipment and techniques for determining the density of corrosive liquids at temperatures above 64°C are presented. The pycnometers, used with UF_6 at 65, 70, 80, and 90°C in this experiment, apply equally well to nonvolatile and inert liquids. Standard deviation of a single ratio measurement is ±0.001 g/cc while the accuracy of the method is -0.0001 ± 0.0004 g/cc as estimated from mass spectrometrically measured isotopic abundances and known molar volumes. (P.C.S.)

45010 (LA-1721(3rd. Ed.)) COLLECTED RADIOCHEMICAL PROCEDURES (RADIOCHEMISTRY GROUP J-11). Kleinberg, Jacob (comp.) (Los Alamos Scientific Lab., N. Mex.). Sept. 1967. Contract W-7405-eng-36. 187p. Dep. CFSTI.

The chemistry of the elements on the basis of electronic configuration is discussed. Separations and radiochemical techniques in the determination of Sh, As, Ba, Be, Bi, Cd, Ca, Ce, Cs, Cl, Cr, Co, Cm, Ge, Au, In, Fe, rare earths, Rh, Mg, Mn, Mo, Np, Ni, Nb, Pd, P, Pu, Pr, Rh, Ru, Sc, Ag, Na, Sr, sulfate, Ta, Te, Tl, Th, Sn, transactinides, W, U, Y, and Zr are presented. (M.C.G.)

45011 (N-67-19093) RESEARCH ON ELEMENTAL ABUNDANCES IN METEORITIC AND TERRESTRIAL MATTER. Summary Progress Report, September 1, 1965-September 30, 1966. Schmitt, R. A. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Contract NASw-843. 35p. (NASA-CR-82505; GA-7424). CFSTI.

Abundances of Na, Sc, Cr, Mn, Fe, Co, and Cu were determined by instrumental neutron activation analysis in some 58 specimens of meteorites and 5 terrestrial samples. Results of these analyses are tabulated along with abundances for these same elements determined previously in some 75 meteoritic specimens. Also included are tables listing the final mass weighted average abundance in each meteoritic class and the calculated atomic abundance of the final mass weighted average abundance relative to the conventional standard of 10^6 Si atoms; correlation coefficients of six possible pairs of lithophilic elements Na, Sc, Cr, and Mn, and of the three pairs of the three siderophilic elements Fe, Co, and Cu; the final abundance of the seven elements Na through Cu in some 596 individual chondules separated from 28 chondritic meteorites; average abundances of Si in chondrules; and correlation coefficients for Na, Sc, Cr, Mn, and Fe with Si in chondrules. (STAR)

45012 (N-67-23945) RARE-EARTH ANALYSIS BY A MASS SPECTROMETRIC STABLE ISOTOPE DILUTION TECHNIQUE. Schnetzler, C. C.; Thomas, H. H.; Philpotts, John A. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). [1967]. 12p. (NASA-TM-X-55765; X-641-67-166). CFSTI.

A technique for the determination of rare earth abundances in rocks and minerals by mass spectrometric stable isotope dilution was developed. The technique is being used for routine determination of europium and the seven even-atomic-number rare earths; this is sufficient to clearly delineate the general rare earth abundance pattern. The method yields results that are comparable, if not superior, in quality to those of neutron activation. Rare earth abundances in the rock standards W-1 and G-1 were determined. (auth) (STAR)

45013 (NYO-2794-14) ABUNDANCE AND DISTRIBUTION OF CHLORINE IN IRON METEORITES. Berkey, E.; Fisher, D. E. (Cornell Univ., Ithaca, N. Y. Dept. of Engineering Physics). Feb. 3, 1967. Contract AT(40-1)-3585. 48p. (CURL-17; CONF-670524-2). Dep. CFSTI.

From Symposium on the Origin and Distribution of the Elements, Paris, France.

The abundance and distribution of chlorine in iron meteorites has been studied by neutron activation analysis and metallographic observation. It was found that the chlorine content of finds can be profoundly influenced by the effects of terrestrial weathering, being enhanced in some meteorites by many orders of magnitude over certain localized regions. The pathways used in the contamination process appear to be cleavages, grain boundaries, Neumann lines, and even direct passage through the metal matrix. Measurements of primordial (non-terrestrial) chlorine in the meteorites show that it is inhomogeneously distributed in the metal phase. The element is strongly depleted in kamacite and tends to concentrate at grain boundaries and around inclusions. It is difficult to calculate an average value for the primordial chlorine content of irons on the basis of the data obtained, but indications are that a representative value is much lower than previous data which were not sufficiently cognizant of contamination effects. (auth)

45014 (ORNL-4145, pp 266-8) SPECTROPHOTOMETRIC STUDIES OF SOLUTIONS OF ALPHA-ACTIVE MATERIALS. (Oak Ridge National Lab., Tenn.).

The ultraviolet and visible spectra of the uranyl ion in perchlorate solution were resolved into 24 adsorption bands. A spectrophotometer system for high alpha levels was installed and is being tested. (M.C.G.)

45015 (TID-24084) THE DETERMINATION OF O/U RATIOS IN $UO_{2\pm x}$. Schaefer, E. A.; Menke, M. R.; Hibbits, J. O. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). Apr. 1966. Contract AT(40-1)-2847. 15p. (GE-TM-66-4-9). Dep. CFSTI.

The accuracy of the ignition method currently in use at GE-NMPO for determining oxygen-to-uranium (O/U) ratios in $UO_{2\pm x}$ was evaluated using both high purity uranium metal and NBS Standard 950a (uranium oxide) as standards. It was found that the method yields results accurate to within ±0.005 O/U units. (auth)

45016 (WASH-1076, pp 65-72) ANALYTICAL MEASUREMENT METHODS AS APPLIED TO SAFEGUARDS. Rodden, Clement J. (New Brunswick Lab. (AEC), N. J.).

Problem areas in analysis of fuels for safeguards systems are considered. Analysis of feed materials for ^{235}U is described. Nondestructive methods of determining ^{235}U in fuel rods are discussed. Analysis of fabrication scrap and of solutions from fuel reprocessing is also described. Analysis of fuel in various stages for plutonium is also discussed. (M.C.G.)

45017 (WASH-1076, pp 96-114) NONDESTRUCTIVE REACTOR FUEL ASSAY. McGonnagle, W. J. (Associated Midwest Universities, Lemont, Ill.).

Problems in the assay (nondestructive) of unirradiated and irradiated reactor fuel are discussed. Methods considered for unirradiated fuel assay include: reactivity changes, fission by thermal neutrons, absorptiometry, and gamma spectroscopy. Methods discussed for irradiated fuel assay include: activation of foils, spectrometry, calorimetry and thermal conductivity, measurement of prompt and delayed neutrons, activation analysis, capture gamma measurements, neutron transmission, and use of stable isotopes. (M.C.G.)

45018 (WASH-1076, pp 115-29) THE POTENTIAL OF HIGH-RESOLUTION GAMMA-RAY SPECTROMETRY FOR THE ASSAY OF IRRADIATED REACTOR FUEL. Heath, R. L. (Idaho Nuclear Corp., Idaho Falls).

A summary is presented of the state-of-the-art in the development, use, and possible application of the lithium ion-drifted germanium gamma detector to the problem of fuel assay. (M.C.G.)

45019 (WASH-1076, pp 130-7) THE NONDESTRUCTIVE ANALYSIS OF SPENT REACTOR FUEL BY GAMMA-RAY SPECTROSCOPY. Rasmussen, N. C. (Massachusetts Inst. of Tech., Cambridge).

A small Ge(Li) detector with an active volume of ~0.6 cm^3 was used to detect the γ spectra from spent fuel elements from the MIT reactor. Most of the measurements were carried out under water in the spent-fuel-storage pool. It is shown that a gamma-scanning technique can yield reliable information about the irradiation history of the highly enriched MTR plate-type fuel elements. It is possible to determine flux, irradiation time, and exposure, and then to calculate burnup to an accuracy of better than 10%. (M.C.G.)

45020 (WASH-1076, pp 138-49) USE OF PHOTOINDUCED REACTION PROCESSES FOR NONDESTRUCTIVE NUCLEAR MATERIALS SAFEGUARDS APPLICATIONS. Beyster, J. R. (General Dynamics Corp., San Diego, Calif. General Atomic Div.).

Characteristics desirably in any safeguards interrogation system for nuclear materials are discussed. Relative intensities of photoinduced reactions attainable with the class of small electron accelerators envisaged for safeguards applications are compared. Distinguishing characteristics of photofission processes are considered along with the possibilities of developing signatures for nuclear materials based on the photofission proces (M.C.G.)

45021 (WASH-1076, pp 150-71) NONDESTRUCTIVE DETECTION, IDENTIFICATION, AND ANALYSIS OF FISSIONABLE MATERIALS. Keepin, G. Robert (Los Alamos Scientific Lab., N. Mex.).

Basic technical requirements in nuclear-safeguards implementation are reviewed. Methods of delayed-neutron kinetic response for nondestructive detection, identification, and analysis of fissionable materials are described. The major technique involves pulsing a system or sample of unknown composition with an intense "instantaneous" pulse of neutrons and analyzing the measured kinetic behavior of delayed-neutron activity following the pulse. Time-fiducial methods were used in the analysis. Applications of the methods in safeguards are considered. (M.C.G.)

45022 (CEA-tr-R-1512) METHODE DE DOSAGE COMPLEXOMETRIQUE DE L'URANIUM TETRAVALENT AVEC UTILISATION DE L'ARSENAZO I COMME INDICATEUR. (Meth of Complexometric Determination of Tetravalent Uranium by Use of Arsenazo I as Indicator). Klygin, A. E.; Nikolskaya, N. A.; Koliada, N. S.; Zavrayanova, D. M. Translated into French from Zh. Anal. Khim., 16: 110-12(1961). 11p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

A complexometric method for determination of U based on its

reduction to the tetravalent state by formamine–disulfonic acid and its titration with a solution of Complexone III in the presence of Arsenazo I was reported. The method is suitable for the determination of U in its salts, oxides, alloys, tributyl phosphate, and other extracts. (tr-auth)

45023 (ORNL-tr-1789) RADIOCHEMICAL DETERMINATION OF THE FISSION-PRODUCT RELEASE FROM COATED FUEL PARTICLES IN REACTOR IRRADIATION. Reidel, H. J. Translated by Martha Gerrard (Oak Ridge National Lab., Tenn.), from German report EUR-3271.d. 8p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

An important question in the use of coated particles as nuclear fuel carrier in operation of a high-temperature gas-cooled reactor is how much of the gaseous and nongaseous fission products penetrates the coating. The pyrolytic carbon coating can prevent contamination of the reactor cooling circuit with high-activity fission products. As part of a research program on the behavior of various types of particles as a function of operating temperature, burnup, etc., a radiochemical study was made of fission-product distribution when the coated particles were surrounded by graphite. For analytical separation and determination of the fission elements distillation, precipitation, liquid extraction, and ion exchange were used. The methods are described briefly. Twelve fission nuclides were determined. A surprisingly high mobility was found for barium, strontium, and yttrium. The release of other fission products with high fission yield was considerably lower. Some of the conditions affecting the fission product yield are discussed. (auth)

45024 DETERMINATION OF OXYGEN IN USGS ROCK STANDARDS BY FAST-NEUTRON ACTIVATION. Volborth, Alex; Vincent, H. A. (Univ. of Nevada, Reno). Nucl. Appl., 3: 701-7 (Nov. 1967).

Oxygen was determined by irradiating powdered rock samples with 14-MeV neutrons in a dual-transfer system and counting the 6.1- and 7.1-MeV gammas of ^{16}N and their escape peaks. Corrections for beam instability, tritium target decay and spottiness, and electronic drift were made by consecutively switching samples to be irradiated and counted at opposite stations. Corrections must be made for the fluorine content of rocks. Reagent chemicals can be used as standards. The method is very precise, and interferences in the high-energy gamma region are undetectable. Two sets of data are given: uncorrected random results, with statistical evaluation of the precision of the method, and recommended results obtained from reanalyzing samples that showed standard deviations of 0.25% oxygen. Analysis of variance for rock samples shows that the USGS standards can be considered homogeneous for oxygen by this technique. (auth)

45025 DETERMINATION OF OXYGEN BY REDUCTIVE MELTING UNDER A STREAM OF ARGON. STUDY OF BLANKS APPLICATIONS FOR ANALYSIS OF REFRACTORY METALS AND ALLOYS. Migaud B. Rev. Met. (Paris), 63: 137-48 (1966). (In French).

A specific apparatus used in this method and the manner of performing blank tests on it are described. With such tests, the contribution of each of the principal sources of parasite oxygen to the total blank was determined for different operating conditions. Although the level of the blanks was high (30 to 60 micrograms, depending on operating conditions), their reproducibility was good enough to permit determinations within 2 ppM in the most favorable case (Ni, Co). After this study of blanks, the conditions of reduction (dilution, temperature, time required) were established for determination of O in Mo, Nb, Ti, Ta, and Zr. For all these metals, a Ni or Co bath was found to be better than a Pt bath. The conditions of reduction, which vary from one metal to another, limited the possibilities of determining low O_2 contents, particularly in the following cases: when dilution should not be too high—for example, since the bath cannot contain more than 5% Ti, the method probably does not permit determination of less than 50 to 100 ppM of O in Ti; if reduction must be carried out at high temperature (1900°C or above)—this is the case, for example, of Nb, where it is difficult to go below 20 ppM and where 10 ppM is probably the lowest determination that can be made; if a temperature problem and a dilution problem exist at the same time—in this case, it would probably be very difficult to go below 100 to 150 ppM of O. None of the metals studied in this report falls into this category. Since the tests showed that analysis of O in pure metals (Ti, Zr, etc.) was possible in an Fe or Ni bath at 1700°C, the method is therefore applicable to superrefractory alloys containing less than 5% Ti. It is even possible to operate without a bath. (Rev. Met. Lit.)

45026 DETERMINING HYDROGEN CONTENT IN NIOBIUM BY HIGH-TEMPERATURE VACUUM HEATING. Lakomskii, V. I.; Kalinyuk, N. N. Avtomat. Svarka, No. 6, 21-4(June 1966). (In Russian).

Experiments were performed in extracting hydrogen from Nb using a graduated heating process. Heating was started at 650 to 900°C, then raised to the 1100 to 1500°C range. Almost all the hydrogen was extracted at 1400°C in a period of 10 min from Nb specimens weighing 0.15 to 0.30 g. Further experiments were made in determining hydrogen content in Nb using an analytical insulation designed for high-temperature vacuum heating. Using this installation at an operating temperature of 1400°C, hydrogen content was determined with an accuracy that compares favorably with the same determination by vacuum melting. (Rev. Met. Lit.)

45027 THE NUCLEAR ANALYSIS FACILITY OF TEXAS NUCLEAR CORPORATION. Parker, C. V. (Texas Nuclear Corp., Austin). Isotop. Radiat. Technol., 4: 117-19(Winter 1966-1967).

The Texas Nuclear On-Line Neutron Activation Analysis Facility was set up for industry to use in making feasibility studies on process-control applications. Material is run on a conveyor under a neutron generator, and the prompt and delayed gamma radiations produced are analyzed on a multichannel analyzer as a series of conveyors carries the material to a storage hopper. (auth)

45028 ACTIVATION ANALYSIS AT GENERAL ATOMIC. Lukens, H. R. Jr. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Isotop. Radiat. Technol., 4: 119-24 (Winter 1966-1967).

The activation-analysis facilities at General Atomic Division, General Dynamics Corporation, San Diego, include 3 TRIGA reactors that can provide pulsed neutron fluxes up to 10^7 n/(cm^2)(sec) as well as steady-state irradiators of lower flux levels; 2 General Atomic Linacs that can produce monoenergetic electron beams at any energy up to 45 MeV, and converters to produce bremsstrahlung for photoactivation analyses; 2 Texas Nuclear Cockcroft–Walton accelerators that can generate 2.5-mA beams of deuterium ions at 150 kV and can produce up to 2.5×10^{11} 14-MeV n/sec. Associated with this equipment are automated analytical systems that permit a wide spectrum of analyses by activation. (auth)

45029 RADIOACTIVE SUBSTOICHIOMETRIC ISOTOPE-DILUTION PROCEDURE FOR THE DETERMINATION OF RARE EARTH METALS. Briscoe, G. B.; Dodson, A. (Univ. of Aston, Birmingham, Eng.). Talanta, 14: 1051-60(Sept. 1967).

A theory is developed which describes the equilibrium conditions when solutions containing trace metals and substoichiometric amounts of EDTA are extracted with thenoyltrifluoroacetone. Experimental evidence is given to support the theory. A method for the determination of microgram quantities of rare earth metals is outlined as an application. (auth) (UK)

45030 MASS SPECTROMETRIC ANALYSIS OF HIGH-PURITY HELIUM AND HYDROGEN, USING A DYNAMIC SAMPLING AND CALIBRATION SYSTEM. Parkinson, R. T. (Royal Arsenal, London). Talanta, 14: 1037-50(Sept. 1967).

A dynamic gas sampling system was designed for use with a mass spectrometer (A.E.I. Model MS2G). It is capable of sampling directly from gas streams at pressures in the region of 800 torr and was satisfactorily used for the analysis of high-purity helium and hydrogen containing less than 50 ppM total impurity. The overall sensitivity is 1 ppM or better. The design permits the mass spectrometer to be used with its normal gas sampling system when required. A dynamic gas blending rig, incorporating a recirculation and purification system, was developed for calibration of the mass spectrometer over the range 5 to 100 ppM of impurity content. (auth) (UK)

45031 DETERMINATION OF RADIOACTIVE COBALT IN REACTOR COOLANT WATER BY SOLVENT EXTRACTION. Motojima, Kenji; Bando, Shoji; Tamura, Nori (Japan Atomic Energy Research Inst., Tokyo). Talanta, 14: 1179-83(Oct. 1967).

A rapid extraction separation method is described for the radiochemical determination of ^{58}Co and ^{60}Co in reactor coolant water. After adjustment of the pH of the sample water to 5.0 to 5.5, cobalt diethyldithiocarbamate is extracted with benzene. Other nuclides, e.g., ^{54}Mn, ^{56}Mn, ^{64}Cu, and ^{59}Fe, which are usually present in reactor coolant water, are also extracted together with cobalt. These can be readily removed by washing the extract with mercury(II) chloride solution. The ^{58}Co and ^{60}Co activities are measured by gamma counting of an aliquot of the washed extract. Trace amounts of radioactive cobalt in 500 ml of sample water can be quantitatively extracted without the use of carrier. The separation could be finished in 15 min and an average recovery of 99.5% was obtained, with a relative standard deviation of 1.4% (25 experiments). (auth) (UK)

45032 APPLICATION OF THIN-LAYER CHROMATOGRAPHY TO THE SEPARATION OF ORGANIC IONS. II. SEPARATION OF TRACE AMOUNTS (ppM) OF RADIOACTIVE Mn AND Hg IN

SOLID MATRIXES OF Al AND Ag. Bottura, Giorgio (Centro Nazionale di Chimica delle Radiazioni e dei Radioelementi, Bologna). Ann. Chim. (Rome), 57: 148-58(Feb. 1967). (In Italian).

A neutron activation method, combined with thin-layer chromatography for radiochemical separation, was developed, especially for determining trace amounts of Mn in Al and of Hg in Ag (both pairs in concentration ratios of 10^{-5} to 10^{6}). The elements present in traces were separated from the base elements by thin-layer chromatography on Kieselgel, with particular attention to the most suitable complexing agents and to the chemical activation of the layer. With neutron fluxes of 10^{7} to 10^{8} $n \cdot cm^{-2} \cdot sec^{-1}$, it was possible to detect ^{56}Mn in Al base mixtures in quantities as low as 1 ppM and ^{203}Hg in Ag in quantities as low as 10 ppM. This method demonstrated the possibility of combining thin-layer chromatography, as a rapid method of separation, with neutron activation analysis of inorganic systems, for the determination of trace amounts of certain elements. (BBB)

45033 DETERMINATION OF THE VANADIUM CONTENT OF PETROLEUM PROCESSED IN HUNGARY BY ACTIVATION ANALYSIS. Vajta, L.; Palmai, Gy.; Szebenyi, I.; Toth, G. (Technische Univ., Budapest). Period. Polytech. Chem. Eng., 10: 269-78(1966). (In German).

Because of the short half-life of ^{52}V (3.76 min) it is necessary to find a rapid method for introduction of the sample into the measuring apparatus. A device related to the pneumatic conveyor in the Hungarian reactor was suggested, and a coating material from which the sample was not removed during analysis was developed. The maximum sensitivity of the method, which analyzes the 1.44 MeV photopeak of ^{52}V, was found to be 0.01 $\mu g/ml$. The device was applied to the analysis of various fractions and residues of Hungarian and imported Russian oils. (BBB)

45034 DETERMINATION OF COPPER IN ALLOYS BY FAST NEUTRON ACTIVATION. Daly, P. J.; Hofstetter, K. J.; Schmidt-Bleek, F. (Purdue Univ., Lafayette, Ind.). J. Chem. Educ., 44: 412-13(July 1967).

A neutron generator providing a fast-neutron flux of $\sim 10^{8}$ neutron/cm^2 sec was used to irradiate brass discs of 200 mg/cm^2 thickness and 2.5-cm dia for 10 min. Copper discs of identical dimensions (monitors) were irradiated along with the unknowns. Scalers with built-in high-voltage supply and attached clocks were used in conjunction with G-M counters to measure the induced activities. Almost all (>99%) of the ^{62}Cu decayed within 100 min of irradiation, and therefore the points on the decay curves after this time represented ^{64}Cu activity only. The 12.9-hr decay component was obtained by drawing a straight line through these points. By subtracting the 12.9-hr component from the gross counts, a set of points representing the contribution of the ^{62}Cu activity at various times was obtained. A straight line was drawn through these points and the half-life of ^{62}Cu was evaluated. To determine the percentage of Cu in the brass, each ^{62}Cu decay line was extrapolated to time zero. (BBB)

45035 DETERMINATION OF TRACES OF URANIUM IN ROCKS AND MINERALS BY NEUTRON ACTIVATION. Turkowsky, C.; Staerk, H.; Born, H. J. (Technische Hochschule, Munich). Radiochim. Acta, 8: 27-30(Sept. 1967). (In German).

A neutron-activation method was worked out for determination of traces of uranium in geological materials. The nuclide chosen is 23.5-min ^{239}U. Samples were irradiated for 60 min in a cadmium capsule at a resonance neutron flux $\phi_{res} = 1.3 \cdot 10^{11}/cm^2$ sec using a pneumatic tube system of the FRM München. Fast radiochemical separations in the presence of carrier uranium gave ^{239}U in a radiochemically pure form. Activity measurements were taken on a β-proportional counter nearly 50 min after irradiation. The method described has a sensitivity of 0.005 μg U/100 mg sample with an accuracy of about ±5%. (auth)

45036 ANALYTICAL METHODS FOR ^{85}Kr IN AQUEOUS SOLUTIONS. Setser, J. L.; Rozzell, T. C.; Smith, B. L. (Robert A. Taft Sanitary Engineering Center, Cincinnati). Radiochim. Acta, 8: 18-22(Sept. 1967).

Several methods were investigated or developed for determination of ^{85}Kr in aqueous samples. The objective was to develop methods of analysis in order that ^{85}Kr gas could be used in flowing streams to study their hydraulic, reaeration, and self-purification capacities. Two of the methods developed were applied to actual stream conditions in the field. The details involved in the investigation of the analytical methods are presented. (auth)

45037 ASSAY OF BERYL BY PHOTONEUTRON METHOD. Rai, Lajpat; Dayal, Narendar; Bhatnagar, A. S. (Dept. of Atomic Energy, New Delhi). Indian J. Pure Appl. Phys., 5: 183-4(May 1967).

Quantitative determination of Be in beryl samples was done by measuring the neutron flux produced on irradiating the sample with γ rays from ^{124}Sb. The neutrons thus produced were thermalized in a paraffin wax block and detected by four BF_3 counters. A comparison of the results of BeO contents of 44 samples, determined by the photoneutron method as well as the chemical method, showed a very good correlation. This procedure, therefore, provides a very reliable, quick, and nondestructive method of detecting the presence of beryl and determining its BeO content quantitatively. (auth)

45038 CORRECTION OF TITRATION AGENT CONSUMPTION WITH REFERENCE TO THE PRECIPITATION SOLUBILITY IN RADIOMETRIC AND SIMILAR TITRATIONS. Klas, J. (Technische Hochschule, Bratislava). Collect. Czech. Chem. Commun., 32: 2362-5(June 1967). (In Czech).

In the case of radiometric or similar titrations in very dilute solutions or in cases where the precipitate has a relatively high solubility product, titration agent consumption corresponding to the end point must be corrected to the equivalence point. Equations were derived for the calculation of this equivalence point. Use of the equations is illustrated. (tr-auth)

45039 A TRIAL METHOD OF DETERMINING URANIUM AND THORIUM CONTENT OF ROCKS IN RADIOACTIVE DISEQUILIBRIUM BY NEUTRON ACTIVATION ANALYSIS. 2. Hatuda, Zin'itiro; Nishimura, Susumu; Asayama, Tetsuji (Kyoto Univ.). Mem. Coll. Sci. Univ. Kyoto, Ser. B, 33: 221-6(Mar. 1967).

Newly obtained U and Th contents of some basic lavas from various localities are reported, and as a reference, Ra content of lavas hitherto obtained by other authors are summarized. The samples were mostly of lavas from islands in the Pacific Ocean. U and Th contents were determined by neutron activation analysis. The Th/U ratios ranged from 2.3 to 3.7 for lavas from Sakurajima, Kirishima, and Aso volcanoes in the Kyusyu district, and those from Hakone and Asama volcanoes, while most of the lavas from the islands, (Izu-Ohshima, Miyakejima, and Hawaii) showed higher Th/U ratios (3.8 to 5.8). Considering that the former group of lavas are andesite and the latter basalt, this tendency nearly corresponds to earlier findings that the average ratios for intermediate and basic rocks are 2.6 and 4.0, respectively. For the igneous rocks younger than 10^{6} yr, it was considered that the content of Ra is less than the equilibrium amount relative to U, as the Ra/U ratio in equilibrium is about 3.5×10^{-7}. Andesite lavas from the Kyusyu district and most of the basaltic lavas of Hawaii unexpectedly revealed excessive contents of Ra. Assuming that the Ra determination was correct, the possibility arises that the Ra content of tholeiite lavas will be normal with respect to U content, while that of alkali olivine basalt lavas highly excessive. (BBB)

45040 GAS–LIQUID CHROMATOGRAPHIC ANALYSIS WITH SHORT-LIVED ISOTOPES. Cram, S. P. (Univ. of Florida, Gainesville); Brownlee, J. L. Jr. J. Gas Chromatogr., 5: 353-8 (July 1967).

The direct coupling of gas–liquid chromatography and neutron activation analysis is proposed. Analysis of reactor-irradiated chromatographic effluents was used to characterize the structure of related organohalides, and for elemental analyses. Application of short-lived isotopes to these determinations requires rapid and efficient separations and represents the fastest isotopic separations reported. All experimental conditions were optimized for rapid postirradiation separations. An automated sampling and injection system was designed to interface the pneumatic transfer system with the chromatograph for minimal sample decay times. Radiolysis products were generally separated in less than 3 half-lives to characterize the nuclear pyrolysis reactions. Microthermistor, NaI(Tl) scintillation, and H flame ionization detectors were connected in series and constituted a highly sensitive and selective mode of analysis for simultaneous qualitative and quantitative measurements. Circuits were designed and developed for complete automation of the system including oscilloscopic readout of the detectors as either linear or logarithmic signals. Analysis of a series of halocarbons showed that by cataloging the multiple detector chromatograms, the nuclear pyrolysis patterns distinctly characterize structural differences and may simultaneously provide an instantaneous readout of the simple qualitative spectra. (BBB)

45041 DETERMINATION OF GUNSHOT FIRING DISTANCES AND IDENTIFICATION OF BULLET HOLES BY NEUTRON ACTIVATION ANALYSIS. Krishnan, S. S. (Centre of Forensic Sciences, Toronto). J. Forensic Sci. Soc., 12: 112-22(Jan. 1967).

A method of identification of bullet holes and determination of gunshot firing distances was developed. A neutron-activation technique for investigation of Sb and Cu around bullet holes produced in different materials by firing various firearms and ammunitions showed that these patterns can be utilized in determining the firing distances with sufficient accuracy, up to distances

much beyond the scope of the existing techniques. The experimental procedure to obtain the concentration patterns of Sb and Cu around bullet holes involved firing test shots on a target material of filter paper or clothing; removal of sections of target material at various distances around the bullet hole (concentric circles of 0.5, 1, 1.5, and 2.0 cm dia); thermal neutron activation of these sections in a reactor at a neutron flux of ~10^{13} n/cm^2/sec for 12 hr; and radiochemical separation of the induced activities of ^{122}Sb and ^{64}Cu in the discharge residues by the method outlined. In some experiments, the neutron-irradiated samples were allowed to decay for a few days before counting. In this way the interfering activities had decayed and only the activity due to ^{122}Sb was seen on the γ scintillation spectrum. This enabled the estimation of Sb without lengthy radiochemical separations. Antimony and Cu patterns could be detected in the target at firing distances of more than 10 ft. In contrast, the conventional techniques such as microscopy, Walker's test, and ir photography do not detect the powder residues beyond a firing distance of 5 ft. (BBB)

45042 LANTHANIDES IN BASALTS OF JAPAN WITH THREE DISTINCT TYPES. Masuda, Akimasa (Tokyo Univ.). Geochem. J. (Nagoya), 1: 11-26(1966).

The lanthanides La, Ce, Nd, Sm, Eu, Gd, Dy, Er, and Yb were determined quantitatively in 6 basalts of Japan by isotope dilution methods. The results suggested that the high-alumina olivine basalt was a primary liquid-type material, the primary tholeiite was a primary solid-type material, and the alkali olivine basalt, previously supposed to be primary, was a secondary liquid-type material. This observation is in agreement with conclusions drawn from analysis of the relation between U and Th concentrations. The original depths for the 3 magmas were estimated to be 200, 150, and 220 km, respectively, from the relative enrichment of lanthanides. Genetically a close connection was corroborated for tholeiite and high-alumina basalt. (TSS)

45043 PURITY CONTROL OF URANIUM BY NEUTRON ACTIVATION ASSAY. II. DETERMINATION OF MANGANESE, NICKEL, AND COPPER. Abdel-Rassoul, A. A.; Wahba, S. S. (Atomic Energy Establishment, Cairo). Talanta, 14: 1061-7 (Sept. 1967).

Activation analysis applied to the simultaneous determination of manganese, nickel and copper in different uranium samples, including metallic uranium, uranium concentrates, oxide, acetate, nitrate, and sodium uranate. The analytical scheme developed is based on separation of the uranium by paper chromatography and subsequent determination of these elements in the pile-irradiated residues by simple radiochemical operations. The reliability of the scheme proposed was tested, and the limits of sensitivity of the methods worked out are stated. Microgram concentrations of the elements studied could be assayed in limited quantities of the samples analyzed with a precision of ±15%. Reagent-blank determinations are also considered. (auth)

45044 NEUTRON ACTIVATION ANALYSIS BY STANDARD ADDITION AND SOLVENT EXTRACTION. DETERMINATION OF IMPURITIES IN ALUMINIUM. Alian, A.; Haggag, A. (Atomic Energy Establishment, Inshas, United Arab Republic). Talanta, 14: 1109-19(Sept. 1967).

A separation scheme based on selective extraction in conjunction with the standard addition technique was developed for the determination of impurities in aluminum by neutron activation. Preliminary investigations were carried out on the extractability of Sc, Co, Hf, Fe, Sn, Cd, Zn, Ag, Cr, Ce, Cs, and Rb by TDA (tri-n-dodecylamine) and TBP (tributyl phosphate) from acidic media. The best conditions are predicted for the separation of these elements into fractions suitable for analysis by γ spectrometry. Recovery values of ~90% were obtained for all the elements. (auth) (UK)

45045 BROMIDE ALKOXIDES OF URANIUM. Bhandari, A. M.; Kapoor, R. N. (Univ. of Jodhpur, India). J. Prakt. Chem., 35: 284-7(1967).

The formation of U alkoxide chlorides by reaction of U pentaethoxide with dry hydrogen chloride gas was reported previously. However, it was considered of interest to find a more convenient method for the preparation of bromide alkoxides of U and to study their properties. The reaction between U pentaethoxide and acetyl bromide was therefore investigated. These reactions were found to be exothermic. Reactions of U pentaalkoxides (ethoxide and n-amyloxide) with acetyl bromide in different molar ratios yielded the products: $U(OEt)_4Br$, $U(OEt)_3Br_2$, $U(OEt)_2Br_3$, $U(OEt)Br_4 \cdot CH_3COOEt$, $U(OAm)_4Br$, $U(OAm)_3Br_2$, $U(OAm)_2Br_3$, and $U(OAm)Br_4 \cdot CH_3COOAm$. All these bromide alkoxides were soluble in benzene and were isolated by drying under reduced pressure. (BBB)

45046 BINOMIAL DISTRIBUTION STATISTICS APPLIED TO MINIMIZING ACTIVATION ANALYSIS COUNTING ERRORS. Jurs, P. C.; Isenhour, T. L. (Univ. of Washington, Seattle). Anal. Chem., 39: 1388-94(Oct. 1967).

To investigate the statistical nature of the minimum theoretical error in activation analysis, the binomial distribution was applied to radioactive decay. Equations are derived for radioactive counting cases involving constant background, decaying interferences, known and unknown decaying mixtures, and simultaneous and sequential comparative activation analysis. The iterative computer programs required to solve these equations are presented and discussed along with examples of their application to the resolution of complex radioactive mixtures and the evaluation of the statistical feasibility of analyses dependent on radioactive decay. (auth)

45047 A SIMPLE GELATION PROCEDURE FOR LIQUID-SCINTILLATION COUNTING. Bollinger, James N.; Mallow, William A.; Register, James W. Jr.; Johnson, Donald E. (Southwest Research Inst., San Antonio). Anal. Chem., 39: 1508-9 (Oct. 1967).

It was found that a gel formed from a urea-type inclusion complex of a toluene cocktail serves as an efficient system for the determination of β-emissions. Employing very small concentrations of toluene diisocyanate and the preparation of the toluene cocktail gel is simple and exceedingly rapid. Counting efficiencies are satisfactory. (auth)

45048 ATOMIC-FLUORESCENCE FLAME-SPECTROMETRIC DETECTION OF PALLADIUM, TITANIUM, ZIRCONIUM, CHROMIUM, AND ALUMINUM USING A HOT HOLLOW CATHODE LAMP. Dinnin, Joseph I. (Geological Survey, Washington, D. C.). Anal. Chem., 39: 1491-3(Oct. 1967).

A demountable hot hollow cathode lamp proposed previously as an excitation source in atomic fluorescence flame spectrometry has proved useful for exciting the fluorescence of at least 14 elements. The fluorescence of palladium, titanium, zirconium, chromium, and aluminum was observed for what is believed to be the first time. In addition, the fluorescence response of manganese, cobalt, and iron was verified. The hot hollow cathode possesses numerous advantages as a light source and supplements other sources of excitation in atomic fluorescence studies. (auth)

45049 RADIOCHEMICAL METHOD FOR DETERMINATION OF ARSENIC, BROMINE, MERCURY, ANTIMONY, AND SELENIUM IN NEUTRON-IRRADIATED BIOLOGICAL MATERIAL. Samsahl, Knut (Aktiebolaget Atomenergi, Stockholm). Anal. Chem., 39: 1480-3(Oct. 1967).

A radiochemical method for the determination of As, Br, Hg, Sb, and Se in biological material was developed. It is based on a previously reported procedure for the simultaneous distillation as oxides or bromides of 12 trace elements from sulfuric acid solution. (J.G.B.)

45050 COLORIMETRIC DETERMINATION OF IRON IN PLUTONIUM METAL USING A NITROBENZENE EXTRACTION TECHNIQUE. Plock, C. E.; Caldwell, C. E. (Dow Chemical Co., Golden, Colo.). Anal. Chem., 39: 1472-3(Oct. 1967).

It was found that the standard correction for plutonium (III) interference, heretofore used in the spectrophotometric determination of iron as the ferrous orthophenanthroline complex, was not only low, but there is doubt that a valid standard correction can be applied. The precision of the analysis was considerably improved by separating the interfering plutonium from the iron solution using nitrobenzene extraction. (J.G.B.)

45051 APPLICATIONS OF SEMIPERMEABLE ION-EXCHANGE MEMBRANES TO TRACE ANALYSIS OF METAL IONS BY ELECTROCHEMICAL AND NEUTRON ACTIVATION TECHNIQUES. Eisner, Uri; Rottschafer, J. Mark; Berlandi, Francis J.; Mark, Harry B. Jr. (Univ. of Michigan, Ann Arbor). Anal. Chem., 39: 1466-8(Oct. 1967).

An electrode system using a semipermeable ion exchange membrane as a barrier mounted between the solution and the working electrode was developed for use with anodic stripping voltammetry and neutron activation analysis in the determination of trace metal ions in solutions containing organic surface active agents. The membrane acts as a barrier to large organic molecules but not to hydrated metal ions or some coordination compounds. Experiments with albumin in solutions of silver ions indicated sufficient sensitivity for trace determination of many metal ions by activation and anodic stripping analysis by taking advantage of the preconcentration of the Ag^+ ion in the cation exchange membrane. (J.G.B.)

45052 DETERMINATION OF TRACE ELEMENTS IN CHROMATOGRAPHIC PAPER BY NEUTRON ACTIVATION AND GAMMA SPECTROMETRY. Patek, Peter; Sorantin, Herbert (Reactor Centre, Seibersdorf, Austria). Anal. Chem., 39: 1458-9 (Oct. 1967).

Whatman chromatographic paper No. 3 (185-200 mg/cm^2) was

analyzed for trace impurities, their distribution in different charges, and their influence on the degradation and loss of tensile strength during longer irradiations. (J.G.B.)

45053 APPLICATION OF ION-EXCHANGE CHROMATOGRAPHY TO ACCURATE DETERMINATION OF LEAD, URANIUM, AND THORIUM IN TANTALO-NIOBATES. Strelow, F. W. E. (National Chemical Research Lab., Pretoria). Anal. Chem., 39: 1454-5(Oct. 1967).

A method consisting of a combination of ion exchange chromatographic procedures for separation, and complexometric and gravimetric procedures for the determination of uranium, thorium, and radiogenic lead in tantaloniobates was developed. Provided large amounts of sample are available, highly reproducible and accurate results can be obtained even at low concentrations. Spectrophotometric procedures can be employed with somewhat lower reproducibility when only small amounts of sample are available. The procedure for large samples are described in detail including an improved method for the dissolution of tantaloniobates which introduces only a minimum amount of nonradiogenic lead. (J.G.B.)

45054 RADIOACTIVE TRACER METHODS IN INORGANIC TRACE ANALYSIS: RECENT ADVANCES. A REVIEW. McMillan, J. W. (Atomic Energy Research Establishment, Harwell, Eng.). Analyst, 92: 539-48(Sept. 1967).

The subject is reviewed under the following headings: introduction; isotopic methods, including single isotope dilution, substoicheiometric isotope dilution, isotopic-exchange methods, and concentration-dependent distribution methods; nonisotopic methods, including isotope-derivative and derivative-dilution methods, isotope-displacement methods, and radio-release methods; radiometric titration; and assessment of the practical utility of radiometric methods. (auth) (UK)

45055 SUBSTOICHIOMETRIC SEPARATION IN THE METHOD OF ISOTOPE DILUTION WITH RADIOMETRIC CORRECTION OF THE RESULTS OF ANALYSIS. Shamaev, V. I. (Moscow Order of Lenin Chemical Engineering Inst.). Zh. Anal. Khim., 22: 1310-19(Sept. 1967). (In Russian).

The use of substoichiometric separation for a modification of the isotope dilution method based on radiometric correction of the results is discussed. Certain peculiarities of using substoichiometric separation in the method of radiometric correction and its advantages (higher sensitivity and selectivity of determinations, less time and work needed for the analysis) are considered. Conditions for substoichiometric separation were found, the sensitivity of the determinations and the maximum permissible concentrations of interfering ions were calculated. Some examples of analysis by radiometric correction with substoichiometric separation are given, and the experimental data (pH range, sensitivity, and effect of interfering ions) are compared with the calculated ones. (auth)

45056 DETERMINATION OF BERYLLIUM BY MEANS OF A PHOTONEUTRON SETUP WITH CROWN COUNTERS. Mezhiborskaya, Kh. B.; Ryzhkov, N. N. Zh. Anal. Khim., 22: 1328-32 (Sept. 1967). (In Russian).

A photoneutron setup for determination of beryllium is described in which three SNM-11 crown counters are used. The setup assures necessary sensitivity, high accuracy, and reliability of determinations. (auth)

45057 EXTRACTION-FLUORIMETRIC DETERMINATION OF YTTRIUM IN LANTHANUM SALTS BY MEANS OF 5,7-DIBROMOHYDROXYQUINOLINE. Kirillov, A. I.; Lauer, R. S.; Poluektov, N. S. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim., 22: 1333-7(Sept. 1967). (In Russian).

Solutions of lanthanum, yttrium, and lutetium 5,7-dibromohydroxyquinolinates in organic solvents have a yellow-green fluorescence with an excitation source of the long wave ultraviolet radiation from a mercury tube. Yttrium 5,7-dibromohydroxyquinolinate was extracted by benzene at lower pH values than the similar lanthanum complex. On this basis an extraction-fluorimetric method for determination of yttrium in lanthanum preparations was developed. (auth)

45058 ORGANIC REAGENTS IN THE ANALYTICAL CHEMISTRY OF ZIRCONIUM AND HAFNIUM. COMMUNICATION 2. PHOTOMETRIC DETERMINATION OF ZIRCONIUM USING GALLOCYANINE MS. Mustafin, I. S.; Shchukina, V. S. (Saratov State Univ., USSR. Saratov Polytechnical Inst., USSR). Zh. Anal. Khim., 22: 1338-44(Sept. 1967). (In Russian).

Gallocyanine MS is suggested as a reagent for zirconium. This reagent forms intensely colored water-soluble compounds with zirconium and hafnium in an acid medium. The molar ratios during the complex formation were found and their stability was estimated. Two constants of the acid dissociation of the reagent were determined. Gallocyanine MS was used for determination of zirconium in a nickel-base alloy and zirconium bronze without removing and masking the main element. At a zirconium content of 0.140 to 0.243% the mean relative error was 0.93 to 1.44%. (auth)

45059 PHOTOMETRIC DETERMINATION OF ZIRCONIUM AND HAFNIUM WITH PYROCATECHOL VIOLET IN SULPHURIC ACID SOLUTIONS. Vladimirova, L. M.; Yagodin, G. A.; Chekmarev, A. M. (Moscow Order of Lenin Chemical Engineering Inst.). Zh. Anal. Khim., 22: 1345-9(Sept. 1967). (In Russian).

The possibility was studied for determination of zirconium and hafnium with Pyrocatechol Violet in sulfuric acid solutions of different acidity. It was shown that at H_2SO_4 concentrations of more than 1.5 to 2.0N the results of the photometric analysis did not depend on the acidity and on the time of storing the solutions. At H_2SO_4 concentrations less than 2.0N the error increased with decrease in acidity and increase in the time of storing the solutions. The composition of the zirconium–Pyrocatechol Violet complex was found to be 1:2. A method was suggested for the photometric determination of zirconium and hafnium by means of Pyrocatechol Violet in sulfuric acid solutions of any acidity. (auth)

45060 CONDITIONS FOR THE COMPLEXOMETRIC DETERMINATION OF NIOBIUM. Kuteinikov, A. F.; Lysenko, S. A. Zh. Anal. Khim., 22: 1366-70(Sept. 1967). (In Russian).

Niobium as a complex with hydrogen peroxide slowly reacts with nitrilotriacetic acid (NTA) in the cold in an acid medium. On adding NTA to the solution heated to the boiling temperature (pH 3) a Nb–H_2O_2–NTA complex 1:1:1 was formed almost instantly. Results of back complexometric titration of niobium using the Nb–H_2O_2–complexone III and Nb–H_2O_2–NTA complexes depended to a considerable extent on the concentrations of niobium and the complexones. Direct complexometric titration of niobium with a NTA solution in the presence of Xylenol Orange was possible after acid decomposition of the sample or after acid fusion of niobium pentoxide and dissolution of the melt in 10% sulfuric acid and 5% hydrogen peroxide. Interference of other elements was eliminated by masking. (auth)

45061 COMPLEXOMETRIC DETERMINATION OF BERYLLIUM AND URANIUM BY MEANS OF COBALT. Vinogradov, A. V.; Apirina, R. M.; Pavlova, I. V. Zh. Anal. Khim., 22: 1323-7(Sept. 1967). (In Russian).

A gravimetric method for determining beryllium and uranium based on production of slightly soluble cobalt hexammine compounds with beryllium and uranium carbonate complexes was analyzed. The possibility of using the method for gravimetric determination of uranium in ores and uranium tetrafluoride is shown. It is also shown that titrimetric determination of beryllium and uranium, based on the ratio of Co:Be and Co:U of 1:2 and 2:1, respectively, produced satisfactory results. A modification is suggested for the Mizumi et al. (Bull. Chem. Soc. Japan 32, 593, 1960), complexometric method for determining beryllium and uranium by treating the precipitate with caustic alkali in hydrochloric acid and cobalt titration. Cobalt titration in the presence of Xylenol Orange, masking beryllium with ammonium fluoride, and elution of uranium with 15% ethanol produced satisfactory results in determining from 0.2 mg of beryllium and from 3.0 mg of uranium. The order of error for 0.17 mg Be is ±0.004 mg for and for 8 mg U is ±0.02 mg. (R.V.J.)

45062 DETERMINATION OF MICROIMPURITIES IN GALLIUM ARSENIDE BY A RADIO-ACTIVATION METHOD. Gil'bert, E. N.; Artyukhin, P. I. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk, No. 4, 90-4(Mar. 1967). (In Russian).

A method for estimation (by activation methods) of Au, Ta, Sc, Hf, Zr, K, Na, Cs, Sr, Ba, Mn, Ni, Cr, and rare earths in gallium arsenide, involving extraction separation of elements into groups suitable for γ spectrometric determination is reported. β,β'-Dichlorodiethyl ether, dimethylbenzylalkylammonium chloride, di-n-butylthiophosphoric acid and α-n-nonylpyridine-N-oxide were used as extractants. (auth)

45063 METAL COMPLEXES WITH FLAVONS. PART I. FORMATION CONDITIONS AND STABILITY CONSTANTS. Bilinska-Kozicka, U. (Warsaw Univ.). Rocz. Chem., 41: 1215-20 (1967). (In Polish).

The properties of beryllium, titanium, and uranium(VI) complexes with quercetin and rutin in water–methanol media containing approximately 50 vol % methanol were investigated by spectrophotometric methods. It was found that these compounds absorb at longer waves than quercetin and rutin. This fact may be used for analytical purposes. However, in such experiments

pH values of solutions have to be properly chosen in order to prevent the possibility of change of absorption of the complexes. The application of Job and Asmus methods for determination of the composition of complexes gave 1:1 mole ratio for complexes of beryllium and uranium(VI) with quercetin and rutin, as well as for the titanium complex with quercetin. Only in the case of the titanium–rutin complex was this ratio found to be 1:2. Application of Babko's and modified Asmus' methods to instability constant determinations gave results that agreed within experimental error. These investigations showed that the stability of uranium(VI) and titanium complexes is higher than that of beryllium complexes. The determined stability constants varied from 10^{-6} to 10^{-7} with one exception, the rutin–titanium complex had stability constant on the order of 10^{-12}. (auth)

45064 ALIZARIN 3-SULFONATE AS A CHROMOGENIC AGENT IN THE MICRODETERMINATION OF LANTHANUM. III. A SPECTROPHOTOMETRIC STUDY. Sangal, Satendra P. (Univ. of Nagpur, India). Microchem. J., 12: 321-3(Sept. 1967).

A comprehensive study on the analytical application of La-Alizarin Red S chelate was carried out. The range of adherence to Beer's Law (0.42–10.0 ppM La), sensitivity (0.087 γ/cm^2, Sandell's), and the molar absorptivity (8931) are reported. The effect of added foreign ions on the determinations is also described. (auth)

45065 NEUTRON-ACTIVATION ANALYSIS BY STANDARD ADDITION AND SOLVENT EXTRACTION. DETERMINATION OF SOME TRACE ELEMENTS IN GRANITE AND DIABASE ROCKS. Alian, A.; Shabana, R. (Atomic Energy Establishment, Cairo). Microchem. J., 12: 427-33(Sept. 1967).

A rapid procedure is presented for the determination of Sc, Th, Co, Fe, Ag, Zn, and Hg in granite and diabase rocks by neutron-activation analysis. The induced ^{233}Pa, ^{60}Co, ^{59}Fe, ^{110}Ag, ^{65}Zn, and ^{203}Hg are extracted with TDA, while ^{46}Sc is then separated with TBP. The extracted isotopes are sequentially eluted from the TDA extracts with various acidic solutions; ^{233}Pa and ^{60}Co contained in one of the fractions are subsequently separated by the selective extraction of ^{233}Pa with TTA. The presented method gives satisfactory accuracy and precision. (auth)

45066 RADIOAKTIVE ISOTOPE IN DER ORGANISCHEN CHEMIE UND BIOCHEMIE. (Radioactive Isotopes in Organic Chemistry and Biochemistry). Schuette, H.-R. Organisch-Praeparative Methoden. Band 3. Berlin, VEB Deutscher Verlag der Wissenschaften, 1966. 701p. MDN 78.-.

Problematics of the measurement and application of the weak β emitters ^{14}C and T, important in organic chemistry and biochemistry, are examined in detail. After an introductory chapter in which the general principles of atomic structure, isotopes and radioactivity are reviewed, the methods used for detection of radioactivity are described. These detection methods emphasize the many methods for the measurement of weak β emitters. The principles of radiation protection and the regulations and recommendations concerning radiation protection are treated. The preparation of radioactively labeled compounds is described, including biosynthetic and radiochemical methods. The use of isotope techniques in organic chemistry and biochemistry is then illustrated by a series of examples. (J.S.R.)

45067 REFEREE METHODS FOR THE CHEMICAL ANALYSIS OF NUCLEAR FUELS. American Standards Association N5.7(1965). New York, American Institute of Chemical Engineers, 1965. 63p.

A standard sample of U_3O_8 was prepared by representatives of the nuclear industry and examined and chemically analyzed by nuclear manufacturers, designers, and users. The results, methods, and procedures were correlated against Referee Analyses made with Referee Analytical Methods on the same materials at Oak Ridge National Laboratory. The resulting American Standard Referee Methods for the Chemical Analysis of Nuclear Fuels include: mass spectrometric absolute isotopic analysis of uranium hexafluoride; determination of uranium concentration by automatic controlled-potential coulometric titration; uranium dioxide stoichiometry, by polarographic method; moisture content; separation of fluoride and chloride by fusion pyrohydrolysis; spectrophotometric determination of combined nitrogen in uranium dioxide; determination of impurities in uranium by carrier distillation optical emission spectrography; and carbon determination in metals and oxides by Leco conductometric method. (D.H.M.)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 45066, 45190, 45197, 45204, 45207, 45209, 45210, 45864, 45966, 45981, 45999, 46143, 46783, and 46985.

45068 (ANL-7325, pp 99-135) MATERIALS CHEMISTRY AND THERMODYNAMICS. (Argonne National Lab., Ill.).

Developments are reported for studies on: high temperature materials development; the U–Pu–C system; determination of compositional changes by mass-spectrometric effusion; vaporization of uranium monophosphide; container materials for plutonia-containing systems; congruently vaporizing composition of urania; total vapor pressure of uranium-bearing species and partial pressure of oxygen over urania; transportation studies of the U–Pu–O and U–Pu–C systems; chemistry of fast reactor fuels; electron microprobe application to irradiated test fuel; demonstration of fluidized-bed process for preparation of (U,Pu)C; equipment development for preparation of carbides by the fluidized-bed technique; thermobalance studies; enthalpies of formation of nickel difluoride, zirconium and hafnium diborides, CF_4, and phosphorus trifluoride; thermochemistry of plutonium and uranium compounds; bond energies in sulfur fluorides, selenium fluorides, tellurium fluorides, and chalcogen oxyfluorides; separation of volatile fluorides by fractional volatilization; 1500°C drop calorimeter; 2500°C electron-beam-heated calorimetric system; quartz-crystal thermometry; chemistry of liquid metals; thermodynamics of binary Rb–Cs solutions; solubility of argon in liquid Na; ultrasonic measurements in liquid metallic solutions; liquid sodium coolant chemistry; physical nature of C in Na; and carburization and decarburization of steel. (P.C.H.)

45069 (ANL-7325, pp 179-96) ENERGY CONVERSION. Cairns, E. J.; Tevebaugh, A. D.; Bingle, J. D. (Argonne National Lab., Ill.).

Developments are reported for studies on: lithium hydride cell; phase diagrams and thermodynamics; conductivity of lithium hydride–lithium halide mixtures; Raman spectra of LiH–LiCl system; bimetallic cells with lithium anodes; bimetallic cells with sodium anodes; Li–Se and Li–Te secondary cells; electrolytes for cells with sodium anodes; electrolytes for cells with lithium anodes; thermodynamics of Na–Bi system; liquid-vapor equilibria in Na–Pb system; Na–Bi cell; Na–Pb cell apparatus; regenerator studies; and engineering material corrosion studies. (P.C.H.)

45070 (COO-1109-25) THE SOLID STATE CHEMISTRY OF RARE EARTH OXIDES. Technical Progress Report, 1966-1967. Eyring, Leroy; Jenkins, Michael S.; Sawyer, James O.; Scherer, Volker; Felmlee, Theron L.; Stone, G. Duane; Turcotte, Rheal P.; Warmkessel, Joyce M.; Weber, Gary R. (Arizona State Univ., Tempe). July 10, 1967. Contract AT(11-1)-1109. 209p. Dep. CFSTI.

Eight articles are included; separate abstracts have been prepared for each. (J.G.B.)

For abstracts of individual papers see: 45071–45078.

45071 (COO-1109-25, pp 6-48) PHASE TRANSFORMATIONS AND DISORDER-ORDER PHENOMENA IN RARE EARTH OXIDE SYSTEMS. (Arizona State Univ., Tempe).

Tensimetric and x-ray diffraction techniques were used for studies on a narrow composition region centering on the iota phase (composition $RO_{1.714}$) of pure and mixed rare earth oxides. Interpretations of phase relationships in the cerium–oxygen, praseodymium–oxygen, terbium–oxygen, cerium–praseodymium–oxygen, and cerium–terbium–oxygen systems are presented. (J.G.B.)

45072 (COO-1109-25, pp 49-67) PREPARATION AND X-RAY STUDIES OF THE MONOCARBONATES OF THE LANTHANIDE ELEMENTS. Sawyer, J. O.; Caro, P.; Eyring, L. (Arizona State Univ., Tempe. Dept. of Chemistry).

Hydrated lanthanide oxalates were carefully decomposed under a variety of conditions and the resulting solid materials examined by x-ray diffraction methods. Two polymorphic crystalline forms of Ln_2CO_5 were observed. It is suggested that both are layer type structures built up of slabs of $(M_2O_2^{2+})_n$ polymers and CO_3^{2-} groups. Type I may have the square $(M_2O_2^{2+})_n$ layers found in LnOCl and related phases while type II has the hexagonal $(M_2O_2^{2+})_n$ layers found in the A-type lanthanide sesquioxides. (J.G.B.)

45073 (COO-1109-25, pp 68-74b) A DETAILED TENSIMETRIC STUDY OF THE PRASEODYMIUM OXIDE–OXYGEN SYSTEM. (Arizona State Univ., Tempe).

The effects of close control of pressure and a slow rate of heating (from 1.5 to 0.1°C per minute) on isobaric runs of the praseodymium oxide–oxygen system were studied. Results agreed with those of previously reported faster runs. Hysteresis displayed during phase transformations is to be investigated in detail. (J.G.B.)

45074 (COO-1109-25, pp 75-82) EXPERIMENTS ATTEMPTING TO GROW SINGLE CRYSTALS OF RARE EARTH OXIDES BY VARIOUS TECHNIQUES. (Arizona State Univ., Tempe).

Two methods were used in attempts to grow single crystals of rare earth oxides. A radiofrequency plasma torch was used to grow small single crystals (about 0.2mm) of neodymium and praseodymium oxides over a period of five hours. Initial experiments on growing crystals using three kinds of salt melts, potassium nitrate–sodium nitrate, lead fluoride–bismuth oxide, and lithium oxide–tungsten oxide, were unsuccessful. Future experiments involving a third or hydrothermal method are planned. (J.G.B.)

45075 (COO–1109-25, pp 83-128) ANION DIFFUSION IN SAMARIUM AND NEODYMIUM SESQUIOXIDE. (Arizona State Univ., Tempe).

Studies of oxygen transport in rare earth oxides were continued. Results on oxygen exchange between the gas and solid phase for the systems $Sm_2O_3-O_2$ and $Nd_2O_3-O_2$ are given, along with rate constants for the surface exchange reaction, diffusion coefficients, and activation energies. Experiments with CaO stabilized ZrO_2-O_2 and $Er_2O_3-O_2$ were not successful and will be investigated further. (J.G.B.)

45076 (COO–1109-25, pp 129-87) SPECTRA OF PRASEODYMIUM OXIDES. (Arizona State Univ., Tempe).

Optical spectra of praseodymium oxides were studied in order to determine the arrangement of oxygen and praseodymium atoms. The spectra are attributed to transitions within the $4f^n$ ground state electronic configuration. A discussion of splitting of these levels and some of the integrals are presented. Peaks in the $Pr(OH)_3$ spectrum were assigned, and a tentative analysis was made of some bands of C-type Pr_2O_3. Spectra were obtained at liquid nitrogen temperatures for several of the oxides Pr_nO_{2n-2}. (J.G.B.)

45077 (COO–1109-25, pp 188-93) EXACT SOLUTION OF FICK'S SECOND LAW WITH A FIRST-ORDER EXCHANGE REACTION AT THE SURFACE. (Arizona State Univ., Tempe).

The previously reported approximate solution of Fick's Second Law was found to be inaccurate when used in analyzing diffusion data obtained during investigation of the diffusion of oxygen in rare earth oxides by heterogeneous isotopic exchange. Because of the large diffusion coefficient of oxygen in rare earth oxides and the fact that the reaction can be followed to completion, the approximate solution was found to be inadequate. The diffusion equation was solved using the method of the Laplace transform. (J.G.B.)

45078 (COO–1109-25, pp 194-209) HIGH-TEMPERATURE X-RAY-DIFFRACTION STUDIES. (Arizona State Univ., Tempe).

An effort was made to verify and extend work previously completed on high temperature x-ray diffraction studies of complex oxide systems, particularly the higher pressure region of the PrO_x system. The performance of the high temperature x-ray diffractometer was upgraded in order to improve accuracy of measurements on the hysteresis and pseudo-phase behavior of the oxide systems. (J.G.B.)

45079 (INR–818/XVIII/PP) SINGULARNE ORBITY W ZAGADNIENIU DWU NIERUCHOMYCH CENTROW: WYJSCIOWY PROBLEM KLASYCZNEJ TEORII WIAZAN CHEMICZNYCH. (Singular Orbits in the Problem of Two Fixed Centers: The Starting Point for Classical Theory of Chemical Bonds). Gryzinski, M. (Institute of Nuclear Research, Warsaw (Poland)). 1967. 68p. (In Polish). Dep.

Solutions of the problem of two fixed centers and trajectories passing through the centers of forces are considered. Conditions necessary for existence of closed trajectories were determined and basic types of closed trajectories are discussed. Possibilities of existence of balanced systems, that is, systems with closed trajectories for which the values of the forces acting on the centers averaged over the period of motion are equal to zero, and therefore admit the stability of physical systems with finite masses of both centers such as the ionized molecule of hydrogen, are considered. (auth)

45080 (IS-T-142) KINETICS AND MECHANISMS OF REACTIONS OF CYANOCOBALT AND -CHROMIUM COMPLEXES IN ACIDIC SOLUTION. Birk, James Peter (Ames Lab., Iowa). May 1967. Contract W-7405-eng-82. 144p. Dep. CFSTI. Thesis.

The immediate product of the reaction of Cr^{2+} with the Co(III) complexes $Co(NH_3)_5CN^{2+}$, trans-$Co(NH_3)_4(H_2O)CN^{2+}$ and trans-$Co(en)_2(H_2O)CN^{2+}$, is a metastable intermediate that decays to form $CrCN^{2+}$. On the basis of kinetic behavior (which was independent of the source of intermediate), spectra, and ^{51}Cr tracer experiments, the intermediate was postulated to be the linkage isomer $CrNC^{2+}$ in rapid equilibrium with $CrNCH^{3+}$. The isomerization of $CrNC^{2+}$ followed pseudo-first-order kinetics. The mechanism proposed for the reaction is given. The aquation of $CrCN^{2+}$ followed pseudo-first-order kinetics, with the observed rate constant dependent on $[H^+]$: $k_{aq} = k_{-1}[H^+]^{-1} + k_0 + k_1[H^+]$. Probable configurations of the transition states were proposed on the basis of entropy correlations. In solutions of low $[H^+]$, the aquation is catalyzed by Cr^{2+}, probably by a hydroxide-bridged electron transfer mechanism. Mercury(II) forms an extremely stable complex with $CrCN^{2+}$, presumably $CrCNHg^{4+}$, which aquates more rapidly than does $CrCN^{2+}$ for $[H^+] \lesssim 0.7$ M. The electron exchange reaction of Cr^{2+} with $CrCN^{2+}$ was investigated. Contrary to studies of most other $Cr^{2+}-Cr(III)$ exchange reactions, the second-order rate constant was dependent on $[H^+]$: $k_{ex} = k_0 + k_{-1}[H^+]^{-1}$. Reactions of Cr^{2+} with the higher cyano complexes cis-$Cr(CN)_2^+$, 1, 2, 3-$Cr(CN)_3$ and cis-$Co(en)_2(CN)_2^+$ also produced an intermediate. The decay of the intermediates, not investigated in detail, was in each case slower than the isomerization of $CrNC^{2+}$. (87 references.) (auth)

45081 (NYO–1158-21) ANNUAL PROGRESS REPORT [OF THE CHEMISTRY DEPARTMENT], JUNE 1, 1966–JUNE 1, 1967. Turkevich, John (Princeton Univ., N. J.). June 15, 1967. Contract AT(30-1)-1158. 9p. Dep. CFSTI.

Developments are reported for studies on: metal catalysts; molecular sieves; transition oxide systems; kinetics of homogeneous reactions; and characterization of catalysts. (P.C.H.)

45082 (ORNL–4145, pp 260-1) CHEMISTRY OF PROTACTINIUM. (Oak Ridge National Lab., Tenn.).

A solid protactinium sulfate was prepared by precipitation from fuming sulfuric acid. A protactinium purification procedure was demonstrated, in which fixed Pa_2O_5, together with anion exchange resin, was contacted in a closed circuit with 10M HCl. (M.C.G.)

45083 (ORNL–4145, pp 282-8) PREPARATION AND PROPERTIES OF ACTINIDE-ELEMENT OXIDES. (Oak Ridge National Lab., Tenn.).

Studies of the electrophoretic behavior of thoria sols were essentially completed. The multiple boundaries observed in the Tiselius type of apparatus were shown to be caused by the presence of small amounts ($\sim 10^{-4}$M) of Th^{4+} in the intermicellar fluid. The method of preparation of the sol was not an important variable, and the electrophoretic mobility, in general, was not very sensitive to environmental effects such as changes in pH or ionic strength. Studies of the shrinkage and of the sintering of thoria gels with and without additives were also completed. Attention is now being focused on urania sols, and a few measurements of their viscosities and electrophoretic mobilities were made. The most remarkable effect observed to date is the sharp decrease in the viscosity of concentrated (6.2 to 6.4M) chloride-stabilized UO_2 sols on the addition of a small amount of UO_3. A decrease from 10^4 to 100 centipoises was observed as the calculated oxygen:uranium atom ratio was increased from 2.00 to 2.07. (auth)

45084 (ORNL–4145, pp 293-6) CHEMISTRY OF CARBIDES AND NITRIDES. (Oak Ridge National Lab., Tenn.).

Fundamental studies of the reactions of metal carbides with aqueous solutions were continued. The reactions of high-purity uranium and thorium carbides with 3 to 9M HCl and 6M H_2SO_4 were found to be hydrolysis reactions, yielding hydrocarbons, with no oxidation of the U(IV) or formation of C–S, C–O–S, or C–Cl bonds. In 2 to 18M NaOH some of the tetravalent uranium in uranium monocarbide was oxidized to a higher valence state, with the accompanying evolution of hydrogen; the carbide carbon was hydrolyzed to methane. Other studies showed that the rate-determining step in the hydrolysis of the uranium and thorium carbides probably does not involve cleavage of the H–O bond in the water, since the reaction with D_2O at 80°C was identical to the corresponding reaction with H_2O except that deuterium was substituted for hydrogen in the products. Pronounced differences in chemical behavior between alkaline-earth dicarbides and actinide dicarbides were found. The reactions of calcium dicarbide with 0 to 16M HNO_3 and of barium dicarbide with 0 to 8M HNO_3 yielded acetylene as the only carbon-containing product. In contrast, the uranium and thorium dicarbides yielded complex aliphatic hydrocarbon mixtures when hydrolyzed, and complex aromatic compounds when oxidized by nitric acid. (auth)

45085 (ORNL–4164) CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING MAY 20, 1967. (Oak Ridge National Lab., Tenn.). Sept. 1967. 162p. Dep. CFSTI.

Developments are reported for studies in: nuclear chemistry; isotope chemistry; radiation chemistry; organic chemistry; chemistry of aqueous solutions; electrochemical kinetics and its application to corrosion; nonaqueous systems at high temperature; and chemical physics. (P.C.H.)

For abstracts of individual papers see: 45086–45089, 45145, 45210, 45864, and 46723.

45086 (ORNL–4164, pp 46-56) ORGANIC CHEMISTRY. (Oak Ridge National Lab., Tenn.).

Developments are reported for studies on: mechanism for pyrolysis of iron salts of aromatic carboxylic acids; photoinduced reactions of naphthoyl cyanide; preparation and hydrolysis of 5-exo-phenyl-5-hydroxy-2-exo-norbornyl tosylate; deamination of 3-exo-phenyl-3-hydroxy-2-endo-norbornylamine; analysis of available isotopic data for solvolyses of 2-exo-norbornyl and 2-(Δ^3-cyclopentenyl)-ethyl esters; shielding effects of the phenyl and hydroxyl groups in phenyl-substituted norbornanols; NMR spectra of allyl compounds; 2-ethylhexanohydroxamic acid; extraction of cations with 2-ethylhexanohydroxamic acid; extraction of Fe(III) with 2-ethylhexanohydroxamic acid; and photopolymerization with uranyl salts and tungsten light. (P.C.H.)

45087 (ORNL–4164, pp 57-82) CHEMISTRY OF AQUEOUS SYSTEMS. (Oak Ridge National Lab., Tenn.).

Developments are reported for studies on: thermodynamics of aqueous silver sulfate–lanthanum sulfate solutions; thermodynamic properties of HCl–$LaCl_3$ mixtures; osmotic coefficients of mixed perchlorate solutions; osmotic coefficients of tungstosilicic acid; binding of quaternary ammonium ions by polystyrenesulfonic acid-type cation exchangers; osmotic coefficients of aqueous solutions of tri-n-alkylsulfonium halides at 25°; thermodynamic properties at 25° of aqueous solutions of p-ethylbenzenesulfonic acid and its alkali-metal salts; thermodynamic quantities in the exchange of Zn with Na ions in variously crosslinked polystyrenesulfonate cation exchangers at 25°; near-infrared spectra of aqueous solutions of some tetra-n-alkylammonium bromides; Donnan equilibrium in crosslinked polystyrene cation and anion exchangers; heat of exchange of iodide with chloride ions on a unifunctional weak-base-type anion exchanger at 25°C; ionic interactions in organic ion exchangers; hyperfiltration by dynamically formed membranes; activity coefficient of KCl in aqueous solution as measured with a cation-sensitive glass electrode; and correlation of sea salt concentration with the EMF response of a cation-sensitive glass electrode. (P.C.H.)

45088 (ORNL–4164, pp 95-100) NONAQUEOUS SYSTEMS AT HIGH TEMPERATURE. (Oak Ridge National Lab., Tenn.).

Developments are reported for studies on: high-temperature thermochemistry of the lanthanide chlorides; calorimetric evidence for complexing in charge-unsymmetrical binary fused salt systems such as cadmium (or magnesium) dichloride–potassium chloride; EMF measurements in molten rare earth metal–metal halide solutions; alkali metal–metal halide miscibility in ternary systems; and solubility of metals in their molten fluorides. (P.C.H.)

45089 (ORNL–4164, pp 101-44) CHEMICAL PHYSICS. (Oak Ridge National Lab., Tenn.).

Developments are reported for studies on: effects of temperature on near-infrared absorption spectra of molecules in condensed states; low-temperature heat capacity of potassium hexaiodorhenate; high-temperature enthalpy of potassium perrhenate; paramagnetic resonance of single crystals; paramagnetic resonance of free radicals formed in acetaldehyde, diacetyl, and acetoin solutions during uv photolysis; paramagnetic resonance of liquids during photolysis of nitriles with hydrogen peroxide; crystal and molecular structure of $RbPaF_6$, urea nitrate, nickel(3,5-dimethylpyridine)$_4(ClO_4)_2$, nickel(3,4-dimethylpyridine)$_4(ClO_4)_2$, 3-endo-phenyl-2-endo-norbornanol, N-(ferrocenylmethylene)formamide, 6-mercaptopurine monohydrate, glycolic acid, and manganese iron carbonyl; segmented-body thermal motion analysis program; use of stereoscopic drawings to illustrate the three-dimensional structure of a crystalline protein; Oak Ridge computer-controlled x-ray diffractometer; x-ray diffraction of liquids; crossed molecular beam studies of reactions of atomic deuterium with halogen molecules; collisional excitation of molecular hydrogen; crossed-molecular-beam studies of bimolecular association and unimolecular decomposition reactions; mass spectrometry of decomposition of ammonia by ionizing radiation in a wide-range radiolysis source; mass spectrometric and theoretical evidence for NH_4 and H_3O; and two-stage mass spectrometer. (P.C.H.)

45090 (ORNL–4166) X-RAY DIFFRACTION DATA ON LIQUID BENZENE AT 25°C. O'Malley, J. A.; Narten, A. H. (Oak Ridge National Lab., Tenn.). Oct. 1967. Contract W-7405-eng-26. 23p. Dep. CFSTI.

The scattering of x rays from the free surface of liquid benzene in equilibrium with its vapor has been measured at 25°C. The diffractometer used was specially designed for the study of liquid structure. In this report, both the raw data and the intensity and radial distribution functions derived from them are presented in tabulated form. Intramolecular distances obtained are in agreement with those derived from gas diffraction experiments. (auth)

45091 (ORO–2832–35) HISTONE SUBUNIT MOLECULAR WEIGHTS DETERMINED BY SEDIMENTATION EQUILIBRIUM AT HIGH SPEED. Ansevin, Allen T. (Anderson (M. D.) Hospital and Tumor Inst., Houston, Tex.). Feb. 1967. Contract AT(40-1)-2832. 1p. Dep. CFSTI.

Molecular weights were estimated for four fractions of histone protein purified from calf thymus (fractions F1, F2a, F2b, and F3-III of L. S. Hnilica) using the meniscus depletion, sedimentation equilibrium method. Abnormal lowering of apparent molecular weights due to charge effects was avoided by employing a solvent of high ionic strength. Molecular weight values obtained were in rough agreement with previous N-terminal analyses. The values obtained were 17,000, 12,000, 13,000, and 14,000 daltons, respectively. (P.C.H.)

45092 (TID–24086) LOW TEMPERATURE SHRINKAGE OF THORIA GEL. I. KINETICS. Technical Report Number XXXI. Chang, R. K.; Olson, F. A.; Wadsworth, M. E. (Utah Univ., Salt Lake City. Inst. of Metals and Explosives Research). Jan. 31, 1967. Contract W-7405-eng-26; Subcontract 2176. 74p. Dep. CFSTI.

For Oak Ridge National Lab., Tenn.

The rate of desorption of chemisorbed gases, primarily NO_2, H_2O, and CO_2, from pressed thoria gel pellets was measured by means of the isothermal length decrease of the pellets as a function of time at various temperatures from 25 to 500°C. A kinetic equation based on a fundamental model of the relationship between weight change and length change for an isotropic solid and employing an activation free energy dependent on coverage of the surface by the chemisorbed gases was developed and obeyed by the experimental results. The variation of activation free energy with surface coverage resulted from variations of the activation enthalpy rather than the activation entropy. Values of 11.7 kcal/mole with complete surface coverage and 36.3 kcal/mole for zero coverage were measured for the activation enthalpy, while the activation entropy was −19.5 e.u. The dependence of desorption rate on temperature and hence on coverage was so great that about one-fourth to one-third of the chemisorbed species still remained at T = 500°C. The maximum desorption rate of chemisorbed species was at about 350°C on the basis of these results. Physically adsorbed species, primarily water, were removed up to about 150 to 200°C. Removal of these species did not follow the kinetic desorption equation, which was obeyed by the chemisorbed species. Outgassing above about 150 to 200°C produced a gel that was non-dispersible in water, whereas the gel dispersed readily in water when outgassed below this approximate temperature. (auth)

45093 (TUBIK–4) BEITRAG ZUR UNTERSUCHUNG DES DAMPFDRUCKVERHALTENS SCHMELZFLUESSIGER OXIDE IM HINBLICK AUF IHRE VERWENDUNG IN HOCHTEMPERATUR-KERNSPALTREAKTOREN. (Contribution of the Investigation of the Vapor-Pressure Behavior of Molten Oxides in View of Their Use in High Temperature Nuclear Reactors). Gross, Bodo (Technische Universitaet, Berlin (West Germany). Institut fuer Kerntechnik). Oct. 1966. 144p. (In German). Dep.

In order to test the suitability of the molten oxides SiO_2, Al_2O_3, and ZrO_2 as solvents for UO_2 in a homogeneous high-temperature reactor, a method for measurement of the vapor and dissociation pressures of these oxides was developed. The measurement method was investigated theoretically and the research arrangement used is described. The individual oxides SiO_2, UO_2, ZrO_2, and Al_2O_3 and the binary systems UO_2–ZrO_2 and UO_2–SiO_2 were investigated. As thermodynamic data for the individual components were known from decomposition reactions, a comparison was made of the measured and calculated dissociation pressures. (tr-auth)

45094 (UCRL–17804) HEAT OF SUBLIMATION AND THE EVAPORATION COEFFICIENT OF PRASEODYMIUM TRIFLUORIDE. Skinner, Harry Bryant Jr. (California Univ., Berkeley. Lawrence Radiation Lab.). Sept. 1967. Contract W-7405-eng-48. 22p. Dep. CFSTI.

Thesis.

The sublimation pressure of praseodymium trifluoride was measured in the temperature range 1424 to 1586°K by the torsion-effusion and torsion-Langmuir methods. The equilibrium pressure is given in this temperature range by the expression Log $P_{Atm} = -(2.109 \pm 0.012)\ 10^4/T + 9.371 \pm 0.082$ where the quoted errors are the standard deviations from the least squares fit. The heat of sublimation at 298.15°K was calculated to be 106.6 kcal/mole by the second law method and 103.3 kcal/mole by the third law method. Because the third law calculations are strongly dependent on estimated free energy functions, 106.6 ± 5 kcal is set as the most probable value and uncertainty. Comparison of the Langmuir and Knudsen data yields an apparent evaporation

coefficient of 1.00 ± .04. In consideration of the pitting and fissuring observed for Langmuir surfaces, the true evaporation coefficient is fixed as 0.9 ± 0.1 for the (0001) face. (auth)

45095 (LA-tr-67-82) ON THE URANIUM–HYDROGEN SYSTEM AND THE KINETICS OF URANIUM HYDRIDE FORMATION. Wicke, E.; Otto, Kl. Translated from Z. Phys. Chem. (Frankfurt), 31: 222-48(1962). 33p. Dep. CFSTI. JCL $3.60 fs, $1.19 mf.

Phase studies were made on the U–H system. The unstable α-modification of uranium hydride was produced for the first time in practice in its pure state. The lattice parameter of the α-deuteride (4.150 A) turned out, as in the β-modification, to be 0.01 A smaller than that of the α-hydride. Structural and thermodynamic studies were also made on uranium hydride. The effects of deuterium on thermodynamic properties of uranium hydride are also discussed. (P.C.H.)

45096 (ORNL-tr-1807) PREPARATION OF MONOCRYSTALS OF CALCIUM OXIDE IN A PLASMA FURNACE. Galtier, Francois; Collongues, Robert. Translated by H. S. Pomerance (Oak Ridge National Lab., Tenn.), from Compt. Rend., Ser. C, 264: 87(Jan. 4, 1967). 2p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

Monocrystals of calcium oxide were prepared by the Verneuil method using plasma heating. The crystals are as large as 7 mm diameter and more than 20 mm long. They are perfectly transparent and show a remarkable inertia chemically. (auth)

45097 RELATIVE IMPORTANCE OF INDUCTIVE AND STERIC EFFECTS IN PRODUCING SECONDARY HYDROGEN ISOTOPE EFFECTS ON TRIPHENYL CATION FORMATION. Kresge, A. J.; Preto, R. J. (Illinois Inst. of Tech., Chicago). Contract AT(11-1)-1025. J. Amer. Chem. Soc., 89: 5510-11(Oct. 11, 1967).

Studies on seven deuterated substrates revealed that steric effects make only a minor contribution to secondary isotope effects in the ionization of triphenylmethanol to the triphenyl cation. The explanation must lie in an inductive tightening of ortho, meta, and para C–H bonds. Results indicate that the effects of successive isotopic substitution at ortho, meta, or para positions are cumulative. The isotope effects were all inverse; ring deuteration at any position increased the extent of ionization of triphenylmethanol. (J.G.B.)

45098 REACTIONS OF Th NITRATES WITH PHOSPHORIC ACID AND Na PHOSPHATE IN AQUEOUS SOLUTIONS. Tananaev, I. V.; Rozanov, I. A.; Beresnev, E. N. (Inst. of General and Inorganic Chemistry, Moscow). Izv. Akad. Nauk SSSR, Neorg. Mater., 3: 832-9(May 1967). (In Russian).

Reactions of Th nitrate with phosphoric acid and Na phosphate in aqueous solution were investigated by residual concentration, pH measurement, and electroconductivity. It was shown that the composition of the oxides formed depends on the ratio of phosphate to Th in the original mixture (n). In the system $Th(NO_3)_4-H_3PO_4-H_2O$ at $n \geq 1.6$, acid Th phosphates of variable composition are precipitated and at $n \leq 2.5$, double substituted Th phosphate is formed. In the system $Th(NO_3)_4-NaH_2PO_4$, Na_2HPO_4, $Na_3PO_4-H_2O$ with original ratio of the phosphate to the Th less than the stoichiometric ratio of 1.33, basic Th phosphates were formed. In the system $Th(NO_3)_4-Na_3PO_4-H_2O$ in equilibrium with the solution the secondary Th phosphate is formed with the original ratio $PO_4^{3-}:Th^{4+} \geq 1.33$. In the system $Th(NO_3)_4-NaH_2PO_4$, $Na_2HPO_4-H_2O$ the secondary Th phosphate is formed only at stoichiometric ratios of the original components. In these systems at $n > 1.33$, Th acid phosphate of variable composition is precipitated, which in the system $Th(NO_3)_4-NaH_2PO_4-H_2O$ at $n > 2.5$ is converted into $Th(HPO_4)_2$. In the system $Th(NO_3)_4-Na_2HPO_4-H_2O$ the sorption of Na ions by the precipitate occurs. (Tr-auth)

45099 NEW THORIUM COMPLEXES WITH COORDINATION NUMBER 10. Butter, Ehrenfried (Karl-Marx-Univ., Leipzig). Z. Chem., 7: 199(May 1967). (In German).

A precipitate from methanolic $Th(NO_3)_4$ solution to which TTA, phen, and NH_3 have been added has mp 236 to 238°C and fits an analysis for $Th(TTA)_4(phen)$. An analogous compound, $Th(TTA)_4$ dipy, has also been prepared in similar fashion. The compound also exists in solution, since an ebullioscopic molecular weight was found (1320; calcd., 1297). The ir spectrum is tabulated and compared with that of $Th(TTA)_4$; the spectra of $Sc(TTA)_3$ and $Sc(TTA)_3$phen are included for comparison. The strong band of shortest wavelength (1585 cm^{-1}) was shifted to shorter wave numbers from the phen-free complex, and a shoulder at 1590 cm^{-1} was observed; no influence of the phen on the carbonyls was indicated from the fact that Zr, U, and Ce complexes with TTA do not form phen adducts. Other recent examples of ten-coordination around Th are recorded. (BBB)

45100 NITROSYLRUTHENIUM–NITRO COMPLEXES IN AN AQUEOUS ENVIRONMENT. Bhagat, Surinder K. (Washington State Univ., Pullman); Gloyna, Earnest F. J. Water Pollut. Contr. Fed., 39: 334-45(Mar. 1967).

Ruthenium is a predominant fission product found in reactor fuel-processing wastes, as 2 moderately long-lived radioisotopes, ^{106}Ru, with a half-life of 365 days, and ^{103}Ru, 42 days. Process solutions obtained by dissolution of irradiated nuclear reactor fuel in nitric acid contain varying proportions of 2 classes of nitrosylruthenium (RuNO) complexes, namely, the nitrato and nitro forms. Some RuNO complexes present problems in fuel-reprocessing operations. Hence, study of the chemistry of these complexes under the acid environments which prevail in the fuel-reprocessing operations is essential. It was found that separation and identification of various complex species of dinitronitrosylruthenium, $RuNO(NO_2)_2OH(H_2O)_2$, in aqueous solutions can be achieved through paper chromatographic and ion exchange techniques. The influence of pH, organic acids, and aging on the distribution of the various species was investigated. Similarly, the actual chemical changes in the complex structure were determined by spectrophotometry and ir spectroscopy. Chromatographic data indicated the presence of as many as 5 complex species in the aqueous solution of the dinitro compound. Two of the species were more prevalent than the other 3. The dominant species isolated by ion exchange techniques were shown to be mononitro- and dinitronitrosylruthenium with the probable formulas $(RuNO(NO_2)OH(H_2O)_3^+$ and $(RuNO(NO_2)_2(OH)_2H_2O)^-$. The less prevalent species had characteristics of a nitrato-nitro nitrosylruthenium complex. As the pH of the solution was increased, there was a decrease in the dinitro species with the corresponding increase in the mono- and nonnitro species. The rate of change in the distribution of the species with pH appeared exponential. Evidence of hydrolysis of the nitro species at high pH was confirmed by ir spectroscopy. At high pH, these complexes tended to form colloidal dispersions. (BBB)

45101 NEPTUNIUM SULFIDES. Marcon, Jean-Pierre (CEN, Fontenay-aux-Roses, France). Compt. Rend., Ser. C, 265: 235-7(July 24, 1967). (In French).

Five sulfides of neptunium were isolated: NpS_3, Np_2S_5, Np_3S_5, $Np_2S_3(\alpha, \beta, \text{and } \gamma)$, and NpS. The first three are isotypic with their uranium homolog, whereas the three varieties of Np_2S_3 are isotypic with Pu_2S_3. The monosulfide is common to the three elements U, Np, and Pu. (tr-auth)

45102 AMMONIA SYNTHESIS CATALYZED BY URANIUM NITRIDE. II. THE TRANSIENT BEHAVIOR. Segal, N.; Sebba, F. (Univ. of Witwatersrand, Johannesburg). J. Catal., 8: 113-19(June 1967).

Uranium sesquinitride exhibits unusual behavior when used as a catalyst for the ammonia synthesis. Elucidation of its transient behavior was sought for an understanding of the catalysis by U_2N_3. Catalyst behavior of U_2N_3 was a sensitive function of its immediately previous history and a change in the operating conditions (temperature, pressure, gas composition, but not necessarily space velocity) normally gave rise to significant transient effects. These effects were found to be reproducible and were conveniently studied by carrying out a cycle of cooling and heating operations, the synthesis mixture being kept flowing throughout. As an explanation for the transient increase in activity of U_2N_3 catalyst for ammonia synthesis, it is suggested that interstitial nitrogen absorbed into the U_2N_3 lattice at higher temperatures becomes frozen in at lower temperatures. It diffuses to the surface at working temperatures and, being in an active atomic form, interacts rapidly with hydrogen in the synthesis mixture to produce ammonia. (BBB)

45103 AMMONIA SYNTHESIS CATALYZED BY URANIUM NITRIDE. I. THE REACTION MECHANISM. Segal, N.; Sebba, F. (Univ. of Witwatersrand, Johannesburg). J. Catal., 8: 105-12(June 1967).

Uranium sesquinitride catalyst were prepared by treating small slugs of U metal with purified hydrogen at 225°C until all the U had reacted; the temperature was then increased to 850°C and the gas stream changed to purified nitrogen. When not in use the catalyst, which was used in powdered form, was stored in the dark under trichlorethylene, which was shown, by chemical and x-ray analyses, to be inert to uranium nitride. Its catalytic properties were studied at a total pressure of 30 atm in the range 338 to 547°C. An unusual transient behavior was shown by the catalyst. This behavior had its origin in the fact that under some conditions the first few subsurface layers of the catalyst are able to take up additional nitrogen and that under different conditions this extra nitrogen is able to participate in the ammonia synthesis reaction. This further nitridation is favored by higher nitrogen pressure and also by higher temperatures (since at the relatively low temperatures used the

further nitridation of uranium sesquinitride is unable to reach true equilibrium). As a result of these effects the approach to steady state in the rate of formation of ammonia was critically dependent on the immediately previous history of the catalyst. The structure of U_2N_3 and its relation to the catalytic activity are discussed. (BBB)

45104 DEUTERIUM ISOTOPE SOLVENT EFFECT ON FLUORESCENCE. Foerster, Th.; Rokos, K. (Univ., Stuttgart). Chem. Phys. Lett., 1: 279-80 (Sept. 1967).

The fluorescence quantum yield of N,N-dimethyl-1-amino-5-naphthalenesulfonate in D_2O exceeded that in H_2O by a factor 1.75. It is assumed that in this and related cases solute-solvent interaction is directly responsible for internal conversion. (auth)

45105 THE REACTION OF DEUTERIUM WITH CYCLOPROPANE AND METHYLCYCLOPROPANE OVER EVAPORATED METAL FILMS. Anderson, J. R. (Flinders Univ., Adelaide); Avery, N. R. J. Catal., 8: 48-63 (May 1967).

The reactions between cyclopropane or methylcyclopropane and deuterium were studied over evaporated films of Pt, Pd, Ni, Rh, W, and Fe. Deuterocycloalkanes were formed only over W, and this exchange proceeded largely in the absence of multiple exchange. In addition to this exchange, deuteroalkanes from ring opening were formed. Over Pt and Pd, only deuteroalkanes from ring opening were found, but over Ni and Fe, this was accompanied by lower deuteroalkanes from more extensive fragmentation. On all metals, no deuteroalkane from ring opening was produced with less than 2 D atoms per molecule. In the exchange of methylcyclopropane over W, the H's of the methyl group remained inert even at high conversions, and the methyl group had but little effect on the exchange reactivity. However, the deuteroalkanes formed by ring opening over W were produced by extensive multiple exchange that included the methyl group. In all cases cycloalkane adsorption occurred to give a π-bonded precursor, ring opening occurred from this to give a σ-bonded 1,3-diadsorbed species. The deuteroalkanes were formed from the latter. (BBB)

45106 UNCl AS AN INTERMEDIATE IN THE AMMONOLYSIS OF UCl_4 IN FUSED ALKALI CHLORIDES. Tschirne, Georg; Naumann, Dieter (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Z. Chem., 7: 200 (May 1967). (In German).

The usual conditions for reaction of NH_3 with UCl_4 in KCl-NaCl at 800°C were altered so that NH_3 could react only on the surface; a UCl_3-containing solution forced through a B 3 quartz frit at 800°C with Ar was used, so that precipitated nitrides were removed and a slow dripping of the melt was achieved; the rate of dripping was regulated by changing the Ar pressure, and the NH_3 was passed by the lower side of the frit. On cooling, the melt contained a fine crystalline black product, separated by repeated filtration, with an analysis fitting UNCl and with a Debyeogram identical with that of UNCl prepared by standard methods. Other products containing nitrides were also observed, and the results do not rule out the existence of chloride-richer U-N-Cl compounds. (BBB)

45107 HYDROGEN ABSTRACTION IN THE LIQUID PHASE BY FREE RADICALS. Davidson, R. S. (Univ. of Leicester, Eng.). Quart. Rev. (London), 21: 249-58 (1967).

It is stated that one of the most frequently encountered reactions of free radicals is hydrogen abstraction. Information on the abstraction of hydrogen from a variety of hydrogen-containing bonds, in a variety of environments, is reviewed under the following headings: general principles (bond strengths, polar effects, solvent effects); abstraction from alkanes and aralkanes; abstraction from cyclic alkanes; abstraction from cycloalkenes; intramolecular hydrogen abstractions of synthetical importance (the Hofmann-Loeffler, Barton, and related reactions, radical cyclisations); role of hydrogen abstraction in homolytic aromatic substitution; and hydrogen abstraction from carboxylic acids and derivatives, aldehydes, ethers, alkylphenols and alkylthiophenols, alcohols, phenols, oximes, N-H, P-H, and S-H bonds. (UK)

45108 REACTION OF THE SOLVATED ELECTRON WITH WATER IN LIQUID AMMONIA. Dewald, R. R.; Tsina, R. V. (Tufts Univ., Medford, Mass.). Chem. Commun., No. 13, 647-8 (1967).

Solutions of sodium in liquid ammonia react readily with water. This reaction is almost certainly due to solvated electrons, e^-_{am}, and can be written $e^-_{am} + H_2O \rightarrow \frac{1}{2} H_2 + OH^-$. NaOH precipitates readily. The reaction mechanism is incompletely understood. The reaction of t-butyl alcohol with sodium in liquid ammonia was studied and it was confirmed that alcohols do not react completely with sodium. The kinetic data are in agreement with the mechanism for the ethanol-sodium-ammonia system suggested by Jolly (Advances in Chemistry Series No. 50: 27(1965)). As the reaction proceeds the alkoxide ion concentration increases and this reduces the ammonium ion concentration until the overall rate falls to a negligible value. The reaction $RO^- + H_2O \rightleftharpoons ROH + OH^-$ does not proceed far to the right for R = But. Using extreme precautions in solvent purification a value of 16 ± 1 mole^{-1} sec^{-1} was deduced as an upper limit for the rate constant of the $e^-_{aq.} + H_2O$ reaction. The relatively high stability of the solvated electron in liquid ammonia towards reaction with water suggested in these studies is consistent with the conclusion of others that the reaction $e^- + H_2O \rightarrow H + OH^-$ can occur only in liquid water where the solvation energy of the hydroxyl ion is available. (UK)

45109 ON THE PREPARATION OF ANHYDROUS URANYL CHLORIDE AND URANIUM(IV) OXIDE DICHLORIDE. Funk, H.; Andrae, K. (Martin-Luther-Univ., Halle-Wittenberg, Ger.). Z. Chem., 7: 64 (Feb. 1967). (In German).

Anhydrous UCl_4 (10 g) is pulverized in a dry box and placed in a long, dry G 2 frit whose open end is attached by a ground joint to a gas delivery tube. Dry O_2 heated to 350°C is admitted to the frit from below at a rate such that the UCl_4 is stirred to a height 3 times that of its original packing, and the frit is heated to 350°C with an electric oven and the reaction completed by glowing. On cooling, the UO_2Cl_2 is transferred to whatever reaction vessel is required with the exclusion of moisture. The second compound, $UOCl_2$, is prepared by heating $UCl_4 \cdot 4CH_3OH$ or $UCl_3(OCH_3) \cdot 2CH_3OH$ in a stream of dry N_2 slowly to 140°C in an oil bath; the melt is held there until gas evolution ceases and the melt solidifies. (BBB)

45110 CO-ORDINATION COMPOUNDS OF ACTINIDES. I. THE DETERMINATION OF THE STABILITY CONSTANTS OF URANYL COMPLEXES WITH ANIONS OF CARBOXYLIC ACIDS. Miyake, Chie; Nuernberg, H. W. (Kernforschungsanlage, Juelich, Ger.). J. Inorg. Nucl. Chem., 29: 2411-29 (Sept. 1967).

The consecutive and gross stability constants of a number of mononuclear uranyl complexes with anions of common carboxylic acids were determined spectrophotometrically at an ionic strength of 1.0 in aqueous solutions. Great care was exercised to avoid uncontrolled hydrolytic action on the complexes by the solvent. The data show that the maximum ligand number for anions of normal fatty acids increases in parallel with the length of the carbon chain. Further general relations appear between the stability of the uranyl complex and the dissociation constant of the carboxylic acid corresponding to the respective ligand anion. The results for oxalate and lactate furnish experimental proof for the fact that the maximum coordination number of the uranyl ion equals 6. (auth) (UK)

45111 SOLVENT ISOTOPE EFFECTS IN THE ENOLIZATION OF ACETALDEHYDE, ACETONE, AND ETHYL METHYL KETONE AT HIGH ACIDITIES. McTigue, P. T.; Sime, J. M. (Univ. of Melbourne). Aust. J. Chem., 20: 905-10 (May 1967).

Measurements of enolization rates in $D_2O-D_2SO_4$ mixtures and $H_2O-H_2SO_4$ mixtures at high acidities yielded data that support low (c. -7) values for the pK_a values of the protonated forms of acetaldehyde, acetone, and ethyl methyl ketone. (auth)

45112 ABSORPTION SPECTRA IN THE ULTRAVIOLET AND THE VISIBLE OF THE PENTACHLORIDES OF PROTACTINIUM AND OF NIOBIUM DISSOLVED IN VARIOUS MEDIA. Pissot, Anne-Marie; Muxart, Roland (Institute de Physique Nucleaire, Arcueil, France). Radiochim. Acta, 8: 43-9 (Sept. 1967). (In French).

The uv and visible absorption spectra of niobium pentachloride dissolved in perchloric acid and hydrochloric acid as well as in carbon tetrachloride and methanol were measured and compared with the corresponding spectra of protactinium pentachloride dissolved in the same solvents. (auth)

45113 ISOTOPIC EXCHANGE BETWEEN BROMOACETIC ACID AND BROMIDE STUDIED BY ELECTROANALYSIS. Beronius, Per (Univ. of Umea, Sweden). Radiochim. Acta, 8: 57-60 (Sept. 1967).

It is shown that reactions of the type, $RBr + {}^*Br^- \rightleftharpoons R{}^*Br + Br^-$, can be studied by electroanalysis. The results obtained in an investigation of isotopic exchange between bromoacetic acid and bromide ions, followed by depositing small fractions of the inorganic bromide on silver anodes at several reaction times, indicated that the single rate constant may be determined with a precision of better than ±0.5% standard deviation. Measurements were made at 10, 20, 30, and 40°C. The second-order velocity coefficient is given by the expression, $k = 1.43 \times 10^{11} \cdot e^{-20670/RT}$ l/mole/sec. (auth)

45114 THE TERNARY OXIDES OF Mo WITH THE ELEMENTS IV A. Freundlich, William; Thoret, Jean (Laboratoire de Chimie Minerale, Paris). Compt. Rend., Ser. C, 265: 96-8 (July 10, 1967). (In French).

Study of the ternary oxides of Mo(VI) with the elements IV A made it possible to identify and isolate a composition phase AMo_2O_8 (A = Zr, Hf, Th). Monocrystals of $HfMo_2O_8$ were prepared and studied. The system was trigonal ($\bar{3}m$); hexagonal cell with a = 10.01 Å, c = 11.60 Å; Z = 6; d = 4.96. $ZrMo_2O_8$ was isotypic. The phase $ThMo_2O_8$ was confirmed in two allotropic forms α and β. Evidence of a third form γ was found. (tr-auth)

45115 FUSION OF HOMOATOMIC SOLIDS. Elston, Jean (Centre d'Etudes Nucleaires, Saclay, gif-sur-Yvette, France). Compt. Rend., Ser. C, 265: 61-4(July 10, 1967). (In French).

The cohesion energy E_c of a homoatomic solid is bound to its fusion temperature T_f by a relation $-E_c = \Delta_s S_0^s T_f$ analogous to the Trouton rule. The value of $\Delta_s S_0^s$ depends on the ratio T_E/T_f and on the vapor pressure of the solid at the fusion point. (tr-auth)

45116 CRYSTALLINE STRUCTURE OF THE ORTHORHOMBIC PHASE UMo_2O_8. Pailleret, Paulette (Laboratoire of Chimie Minerale, Paris). Compt. Rend., Ser. C, 265: 85-7(July 10, 1967). (In French).

Monocrystals of the orthorhombic phase of UMo_2O_8 were prepared and the cell parameters were measured as a = 20.08 Å, b = 7.32 Å, and c = 4.11 Å. It was assigned to the group P ban-D^42h-(mmm). The densities were measured and the atomic positions and the thermal agitation coefficients were determined and tabulated. Projections of cells on the (001) and (010) planes are given. The studies showed that the Mo atoms are at the center of deformed octahedrons at the summits of which the O atoms are placed. The U has a coordination number 8 and is found at the center of a bipyramid whose base is a nonregular hexagon. The interatomic distances are tabulated. (J.S.R.)

45117 THE NONSTOICHIOMETRIC TELLURIDES OF Mo. Spiesser, Michel; Rouxel, Jean (Faculte des Sciences, Nantes, France). Compt. Rend., Ser. C, 265: 92-5(July 10, 1967). (In French).

Heating in sealed silica tubes of Mo–Te mixtures in different proportions permitted identification of two Mo–Te phases, stable within a composition range defined. The telluride $MoTe_2$ could be obtained stoichiometrically only above 660°C. Nonstoichiometric forms were stable at this temperature up to the limiting composition $MoTe_{1.78}$. Between $MoTe_{1.78}$ and $MoTe_{1.45}$ there was a biphase region. A second phase was found between the composition $MoTe_{1.46}$ and $MoTe_{1.14}$ and has an unpublished x-spectrum. The study was made by radiocrystallographic methods, chemical analysis, and density and conductivity measurements. (tr-auth)

45118 DETERMINATION OF THE PARTIAL PRESSURES OF OXYGEN IN EQUILIBRIUM WITH THE NONSTOICHIOMETRIC OXIDES OF THE SYSTEM U–O FOR 1050°C < θ < 1150°C AND 2.19 < O/U < 2.63. II. CURVE OF THE P_{O_2} ISOTHERMS FOR 1082°C, 1123°C, 1137°C, AND 1150°C. PHASE DIAGRAM. Kotlar, Alain; Gerdanian, Paul; Dode, Maurice (Faculte des Sciences, Orsay, France). J. Chim. Phys., 64: 1135-44(July-Aug. 1967). (In French).

The method of physico-chemical equilibrium between a gaseous phase and an oxide was used to determine the partial pressures of oxygen in equilibrium with the non-stoichiometrical oxides of the system U–O at 1082, 1098, 1123, 1137, and 1150°C for 2.19 < O/U < 2.63. Mixtures N_2–O_2 in well-known proportions were used and the evolution of the oxide was followed by means of a Ugine–Eyraud thermobalance. The phases UO_{2+x}, U_4O_{9-y}, and U_3O_{8-z} have been characterized. The limits of the different fields of the system V–O have been stated with more precision and a phase diagram is proposed for 1080°C < θ < 1150°C. (auth)

45119 THE STABILITY OF METAL TRITIDES–YTTRIUM TRITIDE. Jones, P. M. S.; Edmondson, W.; McKenna, N. J. (Atomic Weapons Research Establishment, Aldermaston, Eng.). J. Nucl. Mater., 23: 309-12(Aug. 1967).

The expansion of pressed pellets of yttrium tritide was investigated. The material grew more slowly than lithium tritide. The data are interpreted as showing that most of the ^3He remains atomically dispersed during the early stages of the release. The fabrication of yttrium tritide compacts for use as a target material is described. (auth)

45120 A NOTE ON AmN AND AmO. Akimoto, Y. (Mitsubishi Metal Mining Co., Omiya, Japan). J. Inorg. Nucl. Chem., 29: 2650-2(Oct. 1967).

Details are given of the methods of preparation of these compounds. The mononitride was prepared by the action of ammonia on americium hydride prepared from americium metal, and also by direct reaction between nitrogen and americium metal. The monoxide was prepared by reaction between americium metal and the stoichiometric amount of oxygen, the latter being generated from Ag_2O by thermal decomposition. X-ray diffraction analysis was performed on both compounds. Clear indications were obtained that both belong to the fcc system. The diffraction patterns are tabulated. It was found that for AmN from ammonia and the hydride a = 5.000 ± 0.004Å, and for AmN from nitrogen and the metal a = 5.005 ± 0.005Å; for AMO a = 5.045 ± 0.003 Å. The slightly larger value for AmN from nitrogen and metal was most likely due to the sample being a mixture or solid solution of AmN and AmO, owing to insufficient purification of the nitrogen. Comparisons are made with Zachariasen's values for AmO. The ^{241}Am used was supplied by ORNL. (UK)

45121 DISSOCIATION ENERGY OF GASEOUS URANIUM MONONITRIDE. Gingerich, Karl A. (Battelle Memorial Inst., Columbus, Ohio). J. Chem. Phys., 47: 2192-3(Sept. 15, 1967).

In a mass spectrometric investigation of the vaporization of uranium mononitride from a tungsten Knudsen cell, the UN molecule was identified in the gas phase. Two sets of measurements of the ion currents of U^+, N_2^+, and UN^+ were performed. One was over uranium mononitride containing a small mole fraction of nitrogen-saturated liquid uranium, the second set of measurements corresponded to a condensed system that contained a liquid-uranium-nitrogen solution as the major component. The UN molecule was first detected at about 2100°K. Species were identified by mass-to-charge ratio, intensity distribution in the molecular beam, and appearance potential measurements. Since the ion intensity of the UN^+ molecule was very low and a depleted uranium (with approximately 0.2% ^{235}U) was used, there was no other spectral peaks available for cross checking the identification. It was not possible to measure the appearance potential for the UN molecule accurately. The limited evidence available indicated it to be approximately 1 eV higher than that of uranium. The dissociation energy for gaseous uranium mononitride, D_0^0 = 126 ± 5 kcal was calculated. The dissociation energy for BN, AlN, and ZrN were also calculated using data from the investigation. (D.H.M.)

45122 DEUTERIUM ISOTOPE EFFECTS IN THE ELECTRON SPIN RESONANCE SPECTRA OF NAPHTHALENE NEGATIVE IONS. Lawler, Ronald G.; Bolton, James R.; Karplus, Martin; Fraenkel, George K. (Columbia Univ., New York). J. Chem. Phys., 47: 2149-64(Sept. 15, 1967).

High-resolution electron spin resonance spectra were obtained of the anion radicals of naphthalene and of 10 different deuterium substituted naphthalenes. The ratio of the proton (a^H) to deuteron (a^D) hyperfine splittings was found to be different from the value $a^H/a^D = 6.514$ expected on the basis of the magnetic moments and spins of the two isotopes and, furthermore, it was also found to be different at the α and β positions. These anomalous a^H/a^D ratios were qualitatively interpreted in terms of vibrational effects, which alter the sigma–pi interactions at the substituted positions. The data indicate that the sigma–pi parameters (Q's) for the two isotopes and at the α and β positions are all different, even when account is taken of the magnetic moments and spins. Deuterium substitution at one position was found to alter the hyperfine splittings of the protons at other positions. The magnitude and sign of these changes, which depend on the position and number of substituted deuterium atoms as well as on the position of the proton, were shown to obey an additivity relationship. The changes in splittings are interpreted as resulting from a redistribution of spin density throughout the radicals. Hückel molecular-orbital calculations were performed in which the resonance integral for bonds adjacent to a deuterium-substituted position were altered by a small amount in order to account for this redistribution in spin density. Good agreement between the experimental and calculated changes was obtained, while similar calculations in which the presumed weak electron–donating effect of deuterium was accounted for by a change in the Coulomb integral at the substituted position were in systematic disagreement to a significant extent with the spin densities at certain positions. It was concluded that ESR data provide a more direct means of evaluating the vibrational perturbations introduced by deuterium substitution than do studies of chemical kinetics. Some of the spectra were of such high resolution that anomalies were introduced because of second-order shifts. These could not be analyzed by the usual approximations, and an Appendix is included on the detailed procedures which were employed. (auth)

45123 ON THE EXCESS HELMHOLTZ FUNCTION OF ISOTOPE MIXTURES. Byrns, F. Louise; Mazo, Robert M. (Univ. of Oregon, Eugene). J. Chem. Phys., 47: 2007-9(Sept. 15, 1967).

It was observed that, if the Helmholtz function of an isotopic mixture was represented by that of a pseudosingle component system with mass $m^* = \pi_\alpha m_\alpha x_\alpha$, where the m_α are the masses of the components, and the x_α their mole fractions, a good approximation was obtained. The Helmholtz function of the pseudo-single component system was obtained via the quantal law of corresponding states. Plausible, though nonrigorous, theoretical arguments for the validity of this observation are presented. (auth)

45124 CHEMISTRY OF THE ELECTRON. Dainton, F. S. (Univ. of Nottingham, Eng. Univ. of Leeds, Eng.). Endeavor, 26: 115-21(Sept. 1967).

The electron has for many years been of fundamental importance in chemical theory, but only comparatively recently has it been possible to treat it as an entity in the chemical rather than the physical sense. The chemical properties of the electron are governed mainly by the fact that it is the simplest known free radical — combining with other free radicals, including other electrons — and that it is readily captured by molecules or ions with high electron affinity. The properties are reviewed under the following headings: preparation of solvated and trapped electrons; physical properties of solvated and trapped electrons; and chemical reactivity of the electron. (auth) (UK)

45125 CARBON ISOTOPE FRACTIONATION IN THE SYSTEM CO_2(GAS)–CO_2(AQUEOUS)–HCO_3^-(AQUEOUS). Deuser, W. G.; Degens, E. T. (Woods Hole Oceanographic Inst., Mass.). Nature (London), 215: 1033-5(Sept. 2, 1967).

Carbon isotope fractionation between atmospheric carbon dioxide and aqueous bicarbonate decreased from 9.2 to 6.8 parts per thousand over the temperature range 0 to 30°C. This fractionation occurred in the hydration stage, not in the passage of atmospheric carbon dioxide through the air–water interface. (auth) (UK)

45126 THE CRYSTAL STRUCTURE OF POTASSIUM HEPTAFLUOROPROTACTINATE(V) AND BONDING IN ML_9 COMPLEXES. Brown, D. (Atomic Energy Research Establishment, Harwell, Eng.); Kettle, S. F. A.; Smith, A. J. J. Chem. Soc. A., No. 9, 1429-34(1967).

Potassium heptafluoroprotactinate (V) is monoclinic, space group C2/c, with four formula units of K_2PaF_7 in a cell of dimensions a = 13.760, b = 6.742, c = 8.145 Å, β = 125.17°. The structure was solved by Patterson and difference syntheses, and refined by least-squares methods. The R factor was 0.067 for 580 independent reflections. Each protactinium atom is surrounded by nine fluorines in a slightly distorted trigonal (prism plus equatorial triangle) array, of which the only strict (crystallographic) symmetry is a diad axis. These PaF_9 groups are linked by unsymmetrical two-fluorine bridges into infinite chains. The geometry and bonding of this and related structures are discussed. (auth) (UK)

45127 POTASSIUM PENTACHLOROHYDROXYTECHNETATE(IV). Elder, M.; Fergusson, J. E.; Gainsford, G. J.; Hickford, J. H.; Penfold, B. R. (Univ. of Canterbury, Christchurch, New Zealand). J. Chem. Soc. A., No. 9, 1423-5(1967).

The red precipitate formed when potassium pertechnetate is reduced in HCl with iodide ions is the pentachlorohydroxycomplex $K_2Tc(OH)Cl_5$. The compound has a cubic crystal structure and is isomorphous with K_2TcCl_6. It is paramagnetic and has an electronic spectrum analogous to that of the hexachloro-salt. (auth) (UK)

45128 STUDIES ON ION-EXCHANGE MEMBRANES. PART II. AN ATTEMPT OF AN INTERPRETATION OF THE STATE OF RESIN AT THE "ISOCONDUCTANCE POINT". Narebska, Anna; Basinski, Antoni; Dabek, Roman (Copernicus Univ., Turin). Rocz. Chem., 41: 1329-42(1967).

The specific conductivity of AMF C-60/65 membrane in hydrogen, potassium, magnesium, aluminum, and thorium forms as well as ionic conductivities and mobilities of counter ions in the membrane point to a significant increase of association, which accompanies an increase in counter ion valence. (auth)

45129 COMPARISON OF THE REACTIVITY OF SELENOPHENE, THIOPHENE, AND THEIR METHYL DERIVATIVES BY MEANS OF HYDROGEN ISOTOPIC EXCHANGE METHODS. Shatenshtein, A. I.; Magdesieva, N. N.; Ranneva, Yu. I.; Shapiro, I. O.; Serebryanskaya, A. I. (Moscow Physico-Chemical Inst.). Teor. Eksp. Khim., 3: 343-8(May-June 1967). (In Russian).

The kinetics of the dedeuterization of 2D-, 3D-, 2D- and $3CH_3$, 2D- and $5CH_3$, selenophene with solutions of tert-C_4H_9OK and mixtures of 4M CH_3COOH and 1M CF_3COOH were measured. The reaction capacities in the selenophene and thiophene series during protophyl and electrophyl isotopic exchange reactions were compared. From the comparison of the partial velocity factors of deuteron exchange with acids and with basic heterocyclic compounds, containing atoms of deuterium in the 2-position and CH_3 groups in the 3-, 4-, or 5-positions with partial velocity factors for isomers of monodeuterotoluene, it follows that the electron effect of the methyl group is transmitted analogously in the heterocyclic compounds and in benzene rings. A satisfactory agreement between the comparative constants of the velocity of deuterium exchange in thiophene, selenophene, and their methyl derivatives during catalysis with tert-butylates of the alkali metals in dimethylsulfoxide (DMSO) and in mixtures of tert-butylene with the dimethyl ester of diethyleneglycol was found. This indicates that the data, obtained in tests with DMSO, accurately characterize the reaction capacities of the indicated compounds during exchange with protophyl hydrogen. (tr-auth)

45130 SILOXANE COMPOUNDS OF THE TRANSITION METALS. Schindler, F.; Schmidbaur, H. (Univ., Wuerzburg, Ger.). Angew. Chem. Int. Ed. Engl., 6: 683-94(Aug. 1967).

Heterosiloxanes of transition metals contain the characteristic grouping Si–O–X; in the compounds known so far, X may be Au, Zn, Cd, Hg, Ti, Zr, Hf, V, Nb, Ta, Cr, U, Re, Fe, Co, Ni, or Pt. Most of these compounds are obtained from silanols, metal silanolates, acyloxysilanes, disiloxanes, or alkoxysilanes, i.e. from compounds that already contain an Si–O bond. The transition metal may be introduced e.g. as a halide, as an organometallic compound, as an alkoxy compound, or as an alkoxy compound, or as an oxide. Heterosiloxanes are also formed on reaction of many silicon compounds that do not contain oxygen with transition metal compounds containing oxygen. Some of these compounds, e.g. some titanosiloxanes, are very stable, whereas others decompose explosively. Oligomeric and polymeric heterosiloxanes exist in addition to the monomeric compounds. (149 references) (auth)

45131 SOLVOLYSIS MECHANISMS. SN1-LIKE BEHAVIOR OF METHYL CHLOROMETHYL ETHER. SENSITIVITY TO SOLVENT IONIZING POWER AND α-DEUTERIUM ISOTOPE EFFECT. Jones, T. Chin; Thornton, Edward R. (Univ. of Pennsylvania, Philadelphia). J. Amer. Chem. Soc., 89: 4863-7(Sept. 13, 1967).

Solvolysis of methyl chloromethyl ether in a series of solvents and solvent mixtures gave a Winstein m value (sensitivity to solvent ionizing power) of 1.02 ± 0.03, within experimental error of that (1.00) defined for t-butyl chloride and significantly different from values for typical primary and secondary compounds (m = 0.2 to 0.5). Moreover, methyl chloromethyl ether gave a ratio of rates in aqueous ethanol (of the same ionizing power as glacial acetic acid) vs. glacial acetic acid of ca. 9, comparable with the ratios given by primary compounds (4 to 100) and secondary compounds (5 to 90). The α-deuterium isotope effect for methyl chloromethyl-d_2 ether is k_H/k_D = 1.24 ± 0.08 per deuterium atom (in 2-propanol), in the range typical of reactions involving "unimolecular" dissociation, i.e., conversion of sp^3 carbon hydridization to sp^2. The solvent isotope effect in 95.2% acetone–H_2O (v/v) vs. 95.2% acetone–D_2O is k_{H_2O}/k_{D_2O} = 0.93 ± 0.05. The evidence indicates that methyl chloromethyl ether solvolyzes by a mechanism closely resembling that of t-butyl chloride, i.e., SN1-like, even though the former is sterically much like a primary halide. (auth)

45132 MECHANISMS OF ELIMINATION REACTIONS. IX. THE EFFECT OF ADDED DIMETHYL SULFOXIDE ON RATES AND SULFUR ISOTOPE EFFECTS IN THE REACTION OF 2-PHENYLETHYLDIMETHYLSULFONIUM BROMIDE WITH HYDROXIDE ION IN WATER. Cockerill, Anthony F.; Saunders, William H. Jr. (Univ. of Rochester, N. Y.). J. Amer. Chem. Soc., 89: 4985-7(Sept. 13, 1967).

The rate of reaction of hydroxide ion with 2-phenylethyldimethylsulfonium bromide was affected relatively little by small amounts of dimethyl sulfoxide, but strongly increased by larger amounts (40-fold increase at 7.0 M, and nearly 1000-fold increase at 9.8 M dimethyl sulfoxide). Concomitant with the acceleration was a decrease in the sulfur isotope effect (0.7% in water to 0.1% in 7.0 M dimethyl sulfoxide). The rate increase undoubtedly resulted from a combination of the increased basicity of the hydroxide ion and the solvent effect on the reaction of two ions of opposite charge. The decrease in the sulfur isotope effect appeared, in conjunction with other evidence, to indicate a more reactant-like transition state. (auth)

45133 VIBRATIONAL VS. TRANSLATIONAL ACTIVATION IN THE H_2,H_2 AND H_2,D_2 EXCHANGE REACTIONS. Morokuma, K.; Pedersen, L.; Karplus, M. (Harvard Univ., Cambridge, Mass.). J. Amer. Chem. Soc., 89: 5064-5(Sept. 13, 1967).

Results of a quasi-classical trajectory study for the H_2, H_2 exchange reaction with particular emphasis on the importance of translational and vibrational energy are reported. The calculation employed an approximate potential surface obtained by a semi-empirical valence-bond method of the London–Eyring–Sato type. On this surface the saddle-point configuration for the exchange reaction is a square with side 1.970 au, the barrier height being equal to 62.7 kcal/mole. By Monte Carlo averaging over collision trajectories, the total reaction cross section was determined as a function of the initial vibrational states of the two molecules and their initial relative kinetic energy. A supplementary study was made of the rectangular (D_{2h}) collisions, which proceed through the lowest energy path of the potential surface. The total rate constant obtained was 1.332×10^8 cm^3/mole sec at 1600°K and 1.164 cm^3/mole sec at 1000°K. Results showed that there was no theoretical evidence for a previously suggested

"vibrational threshold." Model calculations showed that an increase in the vibrational energy availability is by itself not sufficient to produce such a threshold; the translational energy must be significantly less effective as well. (D.H.M.)

45134 AROMATIC HALOGENATION. III. KINETICS OF IODINATION OF AZULENE. AMPLIFICATION OF ISOTOPE EFFECTS BY STERIC HINDRANCE. Grovenstein, Erling Jr.; Schmalstieg, Frank C. (Georgia Inst. of Tech., Atlanta). J. Amer. Chem. Soc., 89: 5084-5(Sept. 13, 1967).

The mechanism of electrophilic aromatic substitution in azulene-1,3-d_2 was studied. The catalytic constants for iodination of azulene-1,3-d_2 are given for various bases along with literature values for the acidity of the conjugate acids of these bases. An appreciable isotope effect of sufficient size to be classified as a primary isotope effect was found in the iodination of azulene. The catalytic constant depended on the nature of the base. Water and 2,4,6-trimethylpyridine were less effective catalysts than predicted from their basic strengths. The low-catalytic activity of 2,4,6-trimethylpyridine was attributed to a steric effect involving the 2,6-dimethyl groups on approach of the basic nitrogen to the iodoazulenium cation. The oxygen bases gave an almost constant isotope effect, suggesting a steric effect. (D.H.M.)

45135 VALENCE ORBITALS OF THE LANTHANIDES AND THE ACTINIDES. Villar, G. E. (Univ. of Montevideo). An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. B, 63: 731-7(July-Aug. 1967). (In Spanish).

The valence electrons of the lanthanide elements are on the 4f and 6s orbitals, except for lanthanum and gadolinium whose electronic configurations are supposed to have a valence electron in a 5d orbital. It was concluded that 5d orbitals must not be in the lanthanide configurations, because the said orbitals are characteristic of the d-transition elements that correspond to the period 6 of the Periodic Chart. The series of 5d-transition elements begins with lutetium (Z = 71). In the same manner, the valence electrons of the actinide would be on the 5f and 7s orbitals. The 6d orbitals are apparently not in the actinide configurations, because the said orbitals are characteristic of the 6d-transition elements that begins with lawrencium (Z = 103). The energy levels of the 4f and 5d orbitals are approximately equal. (auth)

45136 KAL'TSII, EGO SOEDINENIYA I SPLAVY. (Calcium, Its Compounds and Alloys). Rodyakin, V. V. Moscow, Izdatel'stvo Metallurgiya, 1967. 186p.

A brief review is given of the physico-chemical properties of calcium compounds and alloys. Preparation and utilization of calcium compounds are discussed and detailed descriptions are given of the phase diagrams and metallurgy of calcium alloys (252 references). (R.V.J.)

45137 EFFECT OF CONCENTRATION DIFFERENCE ON THE RATES OF TRANSFER OF URANYL NITRATE BETWEEN WATER AND TBP. Bush, Dale Edward. Stillwater, Okla., Oklahoma State Univ., 1966. 146p.

Thesis.

The mass transfer coefficients for the transfer of uranyl nitrate between water and TBP were determined in a stirred mass transfer cell under both unsteady and steady-state conditions. The effects of both the concentration difference and concentration level on the rates of transfer were investigated. Activity based mass transfer coefficients were obtained. The simulation of the mass transfer cell was performed on an analog computer. Also included in the study was the determination of the interfacial tension of the uranyl nitrate–water–TBP system. The unsteady-state mass transfer coefficients decreased with time. This could not be explained on the basis of the buildup of an interfacial resistance. The effect of stirring rates on the rates of transfer was greater than that usually predicted. If energy transmitted from the aqueous phase stirring is considered, the mass transfer coefficient varied with the square root of the organic phase Reynolds number. The steady-state mass transfer coefficients for the transfer of uranyl nitrate from water to TBP decreased with driving force and organic phase concentration level. The steady-state mass transfer coefficients for transfer of uranyl nitrate from TBP to water increased with driving force and aqueous phase concentration level. The rates of transfer were controlled by convective diffusion, not molecular diffusion. The interfacial tension measurements for the uranyl nitrate–water–TBP system predict that interfacial turbulence does not occur in this system. (Disser. Abst.)

45138 AN INVESTIGATION OF THE EXISTENCE AND NATURE OF LOWER OXIDES OF THE RARE EARTH ELEMENTS. Felmlee, Theron Leon. Tempe, Ariz., Arizona State Univ., 1967. 129p.

Thesis.

In order to determine whether the lower oxides of the rare earths exist as binary phases or whether they are ternary with carbon or nitrogen, the lower oxides of samarium and ytterbium were investigated. Many experiments were carried out in attempts to prepare bulk amounts of RO_x ($1.5 > x > 0$) by reducing Sm_2O_3 and Yb_2O_3 with samarium and ytterbium respectively, reducing Sm_2O_3 in a hydrogen discharge, carbon reduction of Yb_2O_3, thermal degradation of Sm_2O_3, and controlled oxidation of SmH_2. However, only small amounts of the compound reported to be SmO could be formed, the compound reported to be Sm_2O was actually found to be SmH_2, and YbO could not be prepared. To investigate the possibility that the compound thought to be SmO was stabilized by an impurity, elemental analyses were performed and a considerable amount of nitrogen was found. Ternary compounds, $SmN_{1-x}O_x$ ($0 < x \leq 0.5$), were prepared, and it was found that the preparations with the composition where $x = 0.5$ could explain what was previously thought to be SmO. The lattice parameter of the solution-like compound $SmN_{1-x}O_x$, which has the NaCl structure, increases continuously with decrease in x. This indicates that as the nitrogen of SmN is replaced by oxygen, the 3+ valency of the samarium ion is retained although, formally, the oxygen–nitrogen exchange must result in the reduction of an equivalent amount of Sm^{3+} to Sm^{2+}. $SmN_{1-x}O_x$ undergoes hydrolysis on exposure to the atmosphere, and on dissolving it in acid, hydrogen is evolved. This reaction was formulated as $2SmN_{0.5}O_{0.5} + 7H^+ = NH_4^+ + H_2O + 2Sm^{3+} + \frac{1}{2}H_2$. While trying to reduce Sm_2O_3 with samarium in quartz tubes, a samarium–silicon phase resulted which has a composition of approximately Sm_5Si_3. This was ascertained by analogy between the x-ray powder diffraction pattern of this phase and those of known silicides. However, a literature survey indicated that a compound with the same formula had been prepared with the same structure, but it had much smaller lattice parameters. Experiments were carried out in an unsuccessful attempt to resolve the difference between the two sets of lattice parameters of the compound. (Disser. Abst.)

45139 A PROCESS FOR THE PRODUCTION OF TITANIUM, ZIRCONIUM, OR THORIUM HYDRIDE. (to Deutsche Gold-und Silber-Scheideanstalt Vormals Roessler). British Patent 1,085,854. Oct. 4, 1967. Priority date Aug. 26, 1964, Germany.

The hydrides were produced by reduction of titanium, zirconium, or thorium oxides at normal or slightly high pressure with the exclusion of air using alkali and alkaline earth hydride and halide mixtures at 350 to 750°C and then at 800 to 900°C. (M.C.G.)

45140 SUBSTITUTED AND UNSUBSTITUTED BIPHENOXY-DIPHENYLS AND COMPOSITIONS CONTAINING THE SAME. (to Monsanto Co.). British Patent 1,087,470. Oct. 18, 1967. Priority date Sept. 20, 1963, United States.

Preparation of functional fluids that have high thermal stability at temperatures as high as 800°F, and possess good temperature viscosity, lubricity characteristics, a high oxidation resistance, high radiation stability, low vapor pressure, and are substantially free from corrosive action were investigated. It was found that diphenoxydiphenyls in which at least one of the phenoxy substituents was in the meta position in the diphenyl nucleus, were particularly useful as thermally stable functional fluids. Four isomers, 3,2'-diphenoxydiphenyl, 3,3'-diphenoxydiphenyl, 3,4'-diphenoxydiphenyl, and 3,4-diphenoxydiphenyl, had the suitable physical properties to provide the desired wide temperature fluid range. High-temperature functional fluids may be required as coolant-moderators for nuclear reactors and as heat-transfer agents. (D.H.M.)

Radiation and Nuclear Chemistry

Refer also to abstracts 45085, 45089, 45119, 45187, 45198, 45203, 45212, 45467, 46195, and 46413.

45141 (AD-646299) EFFECTS OF RADIATION ON A SILICONE FLUID. Savage, C. J. (Royal Aircraft Establishment, Farnborough (England)). Sept. 1966. 15p. (TR-66300). CFSTI.

The effects of radiation on a proposed gyroscope damping fluid were investigated. The effects of γ radiation on the viscosity of the fluid are described, together with a quantitative and qualitative analysis of the gases evolved during irradiation. An attempt was also made to determine the minimum radiation dose necessary to produce bubbles of gas in a sealed container of the fluid. (auth) (TAB)

45142 (AD-650121) EFFECTS OF GAMMA IRRADIATION ON URANIUM DOPED CALCIUM FLUORIDE. Final Scientific Report (Part II), October 8, 1965–December 7, 1966. Gravely, Benjamin T. (North Carolina State Univ., Raleigh. School of Physical Sciences and Applied Mathematics). Contract DA-01-021-AMC-13339(Z). 65p. CFSTI.

The effects of ^{60}Co and ^{137}Cs gamma radiation on the 0.2 to

1.1 μ spectral region of CaF2 : U (3+) were studied. Radioinduced absorption bands formed at 0.320, 0.405, and 0.595 μ appear to be the results of three distinct types of centers. The shape of the band at 0.595 μ indicates that there may be several composite bands in this region. The energy levels of these bands lie between 14,000/cm and 18,000/cm, which is just above the quadruplet-$I^{15}/_2$ levels of the imperturbed uranium ions. Decay of the radioinduced center band spectrum due to time and due to optical bleaching with an FX 38A linear flash tube was investigated. The 0.320 μ band decayed less than 15% under flashing, while the 0.405 μ band fell approximately 55% and the 0.595 μ band fell approximately 45%. The effect of gamma radiation on the laser output of a CaF2 : U (3+) rod was examined with the help of a new low-temperature head, which could be placed into the sample compartment of the ^{60}Co irradiator. An increase of 250% was observed over the unirradiated output. (auth) (TAB)

45143 (N-67-18358) CALCULATION OF DENSITY OF DEFECTS FROM GAMMA IRRADIATION. Van Lint, V. A. J.; Geiger, Felix E. Jr.; Nichols, D. K. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). [1965]. 7p. (NASA-TM-X-57168). CFSTI.

A method for calculating the density of defects to be expected from Compton electrons formed by incident γ-irradiation of a given material is described. The calculation involves experimental knowledge of the rate of introduction of defects, $dN_d/d\phi$, where N_d is the density of defects and ϕ the integrated electron flux, the range–energy curve for electrons, and the theoretical spectrum of Compton electrons given by the Klein–Nishina formula. A specific calculation was made for the density of defects at the band energy level 0.17 eV below the conduction band energy in n-type silicon irradiated by 1.37 MeV ^{60}Co γ-rays. (auth) (STAR)

45144 (ORNL-4145, pp 262-5) IRRADIATION EFFECTS ON HETEROGENEOUS SYSTEMS. (Oak Ridge National Lab., Tenn.).

Studies on the radiolysis of adsorbed water were continued in an effort to determine the mechanism by which the adsorbent influences the yield of molecular hydrogen. (M.C.G.)

45145 (ORNL-4164, pp 35-45) RADIATION CHEMISTRY. (Oak Ridge National Lab., Tenn.).

Developments are reported for studies on: flash photolysis of liquid water; effect of oxygen on the primary process in the photolysis of water; flash photolysis and pulse radiolysis of solids; pulse radiolysis and flash photolysis of oxygen; comparison of flash photolysis with pulse radiolysis; nature of the precursor of molecular hydrogen in the radiolysis of water; geminate recombination in photochemistry; energy transfer in radiolysis of organic compounds; chemistry of ^{38}Cl recoils in neutron-irradiated crystalline $NaClO_3$, $KClO_3$, and $KClO_4$; chemistry of ^{82}Br recoils in neutron-irradiated crystalline alkali metal bromates; and chemistry of ^{128}I and ^{130}I recoils in neutron-irradiated crystalline KIO_3 and KIO_4. (P.C.H.)

45146 (ORO-3508-2) DIFFUSION OF RECOIL FISSION FRAGMENTS FROM SOLID SURFACES CALCULATED RELEASE CURVES. Mears, L. Daniel; Elleman, Thomas S. (North Carolina State Univ., Raleigh. Dept. of Nuclear Engineering). Aug. 1967. Contract AT(40-1)-3508. 28p. Dep. CFSTI.

Tables and figures are presented which give the predicted fractions of recoil fission products released from spheres for different diffusion coefficients and heating times. The spheres are assumed to be heated at constant temperature following impregnation with fission recoils. The data cover sphere radii of 0.01, 0.10, and 1.0 cm, and materials of Al, CsI, graphite, stainless steel, UC_2, UO_2, and Zircaloy. (D.L.C.)

45147 (UCRL-17520, pp 11-14) PRODUCT INVENTORY IN THE RADIOLYSIS OF CRYSTALLIINE CHOLINE CHLORIDE. Ackerman, Margaret; Lemmon, Richard M. (California Univ., Berkeley. Lawrence Radiation Lab.). (UCRL-17459).

Quantitative measurements were made of all detectable products from the γ radiolysis of choline chloride. Besides the known major products, trimethylamine and acetaldehyde, only trace amounts of other products (H_2, CH_4, CH_3Cl, Cl_2, crotonaldehyde, and paraldehyde) were detectable. The total yield of these trace products was not more than 3% of the decomposed crystal. (M.C.G.)

45148 (UCRL-17520, pp 15-17) IDENTIFICATION OF SOME NEW PRODUCTS FORMED BY THE IRRADIATION OF SOLID BENZENE WITH ACCELERATED $^{14}C^+$IONS. Pohlet, Helmut; Erwin, Wallace; Lin, Tz-Hong; Lemmon, Richard M. (California Univ., Berkeley. Lawrence Radiation Lab.).

Data are presented showing that diphenylmethane and phenylcycloheptatriene are formed in the reaction of accelerated $^{14}C^+$ with benzene. It is also shown that phenylacetylene is another "post-benzene" product, i.e., compounds appearing after benzene on gas-liquid chromatography. (M.C.G.)

45149 (NP-tr-1577) RADIOLYSIS OF METHANOL BY $^{10}B(n, \alpha)^7Li$ RECOILS. EFFECT OF LINEAR ENERGY TRANSFER ON THE RADIOLYSIS OF METHANOL. Imamura, M. Translated by A. K. Henn (Atomic Energy Research Establishment, Harwell, Eng.), from Rika Gaku Kenkyusho Hokoku, 40: 176-84(1964). 28p. Dep. CFSTI. UK. JCL $2.60 fs, $1.04 mf.

The radiolysis of methanol by $^{10}B(n, \alpha)^7Li$ recoils and the effect of potassium iodide on this process were studied and compared with the radiolysis of methanolic solutions of trimethyl borate by ^{60}Co γ radiation. As compared with γ-radiolysis, radiolysis by recoils gives large G-values for formaldehyde, carbon monoxide, methane, and hydrogen, while the G-value for ethylene glycol becomes small. Furthermore, in the case of γ-radiolysis potassium iodide exerts a fairly substantial influence on the G-values apart from those for carbon monoxide and methane, while its influence is almost nonexistent when radiolysis is carried out by recoils. Treating these experimental results from the point of view of LET effect, it was concluded that the radical $CH_3O\cdot$ plays an important part in the initial stage of the radiolysis of methanol, as well as $\cdot CH_2OH$. The results obtained with potassium iodide solutions indicated that ionic reactions may occur. (M.C.G.)

45150 (ORNL-tr-1774) EXPLOSIVE REACTION BETWEEN IRRADIATED LIQUID NITROGEN AND OXYGEN. Kuri, Zenichiro; Shida, Shoji; Haruhara, Shiro. Translated for Oak Ridge National Lab., Tenn., from pp 284-6 of Nippon Isotope Kaigi Hobun-shu, No. 4, 1961. 7p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

Explosive reactions between irradiated liquid nitrogen or oxygen and various organic compounds were studied. The results showed that most vinyl monomers react with explosive violence when contacted with liquid nitrogen. In contrast, halogen compounds did not explode. The hydrocarbons with relatively high melting points, like benzene or cyclohexane, did not react. Among the polymers tested, only cellophane exploded. Polymerization by liquid nitrogen was also studied. Reactions of liquid oxygen were the same as those with nitrogen except that the irradiation dose had to be 10 to 100 times as great as that for liquid nitrogen. Cause of the explosive reaction and possible mechanisms are discussed. (P.C.H.)

45151 ON THE RELATION BETWEEN CHEMICAL CONSTITUTION AND ISOMERIC EFFECT IN THE SZILARD–CHALMERS REACTION IN COMPLEXES OF Co(III). Lazzarini, Ennio (Centro Studi Nucleari, Milan). Gazz. Chim. Ital., 97: 694-719(May 1967). (In Italian).

The isotopic and isomeric effects in Szilard–Chalmers recoil reactions are briefly described and their dependence upon the chemical constitution of the target is pointed out. Experiments were conducted on the isomeric effect in Szilard–Chalmers recoil of ^{60m}Co and ^{60g}Co. Forty-six Co(III) complexes were examined. It was found that the isomeric effect is chiefly dependent on the first coordination shell of Co(III). Isomerism of cis-trans type has only a secondary role, if any, on the phenomenon. The isomeric effect depends on the abilities of a ligand to split the 3d orbitals of Co(III) and to form π bonds. The isomeric effect is, at least in first approximation, an additive property of the ligands. The contributions to the effect for 18 ligands are reported. Hypotheses are presented to explain the mechanism of the phenomenon. (BBB)

45152 CHEMONUCLEAR AND RADIATION CHEMICAL PROCESS RESEARCH AND DEVELOPMENT. Steinberg, Meyer (Brookhaven National Lab., Upton, N. Y.). Isotop. Radiat. Technol., 4: 142-55(Winter 1966-1967).

The guiding principles and some of the latest results in the development of nuclear energy for synthesis and production of industrial and utility chemicals are presented. Work indicated that fissiochemonuclear processes for fixation of nitrogen, synthesis of ozone, and production of synthesis gas (carbon monoxide and hydrogen) are sufficiently interesting, from a long-term national-goals point of view, to provide ample incentive for continued orderly development of the science and technology of this field. Radioinduced chemical processes using isotopic and machine sources for chain-reaction products will continue attracting further industrial development efforts. (auth)

45153 WOOD-POLYMER COMBINATIONS USING RADIATION TECHNIQUES. Siau, J. F. (Paul Smith's Coll., N. Y.); Meyer, J. A.; Skaar, C. Forest Prod. J., 15: 426-34(Oct. 1965).

Improvement in the dimensional stability of soft woods was demonstrated by impregnation with various monomer solutions and polymerization with ^{60}Co γ irradiation. Irradiation doses used varied from 1.9 to 10.2 MRAD. A very high antishrink efficiency (92%) was obtained when diethylene glycol was used as an initial

swelling agent. A mixture of 10% by volume of methanol in styrene produced sufficient swelling to result in an antishrink efficiency of about 70% after polymerization by irradiation. Similar mixtures of dioxane or dimethylsulfoxide and styrene were unsatisfactory. Methanol and carbon tetrachloride increased the rate of polymerization of styrene by irradiation. Carbon tetrachloride had the greater effect on chain embrittlement of the treated specimens. There was no apparent superiority of specimens impregnated by the high-vacuum method over those done by the solvent exchange method at atmospheric pressure. Degassing of the monomer and swelling agent and the exclusion of air during irradiation was not necessary. Preirradiation of samples before impregnation with degassed styrene monomer yielded completely negative results because no polymer was retained. This was due to the absence of swelling. When 11% methanol was added to the styrene admitted to preirradiated specimens, a polymer retention of 6.4% resulted in an antishrink efficiency of 26%, although many free radicals were probably terminated by the methanol. (BBB)

45154 LARGE SCALE PRODUCTION AND APPLICATIONS OF RADIOISOTOPES. Greene, R. E. Isotop. Radiat. Technol., 4: 156-71(Winter 1966-1967).

The proceedings of the American Nuclear Society National Topical Meeting on large-scale production and applications of radioisotopes, held at Augusta, Ga., Mar. 21 to 23, 1966, are summarized. In addition to three introductory addresses, papers were presented in sessions on large-scale: production of radioisotopes, chemical processing, international programs, applications of radiation, and applications of isotopic power. 72 references. (auth)

45155 PRODUCTION AND USE OF RADIOISOTOPES IN FRANCE. Fisher, C. (CEA, Saclay, France). Isotop. Radiat. Technol., 4: 189-94(Winter 1966-1967).

The production and use of radioisotopes in France are managed chiefly by the Commissariat à l'Energie Atomique (CEA), which manufactures practically all radioisotopes, radiochemicals, and radioactive sources. It also is concerned with research and development on industrial uses of radioisotopes and radiation and helps industry utilize these techniques. The program was integrated with production centers in Belgium and Italy since the early 1960's. The Belgium program is oriented toward production of high-specific-activity radioisotopes in the BR-2 reactor while the Italian program is limited mainly to radiopharmaceuticals. The French program includes production of irradiated materials, processed isotopes, radiopharmaceuticals, labeled organic compounds, and sealed sources for industry. (M.M.B.)

45156 ON THE CROSSLINKING OF PARTIALLY PHENYL-SUBSTITUTED POLYDIMETHYLSILOXANE BY ^{60}Co γ RADIATION. Schnabel, Wolfram (Hahn-Meitner-Institut fuer Kernforschung, Berlin-Wannsee, Ger.). Makromol. Chem., 104: 1-8(1967). (In German).

Copolymers of dimethyl siloxane and phenyl methyl siloxane (type I) as well as copolymers of dimethyl siloxane and diphenyl siloxane (type II), were γ irradiated with ^{60}Co. In the case of type I polymer containing 36 mole % phenyl groups, it was found that scissions in the main chain are negligible compared with intermolecular crosslinking. The 100 eV for crosslinks G(X) decreased with increasing phenyl-group content. At equal contents of phenyl groups, polysiloxanes of type II were less radiation stable than those of type I. For both types of copolymers the 100-eV yield G(X) depended linearly on the electron fraction of the dimethyl siloxane units. It was concluded that phenyl-substituted siloxane units do not protect neighboring dimethyl siloxane units as has been assumed in some previous studies. (BBB)

45157 CHEMICAL EFFECTS OF NUCLEAR PROCESSES IN MIXED CRYSTALS. III. CHEMICAL EFFECTS OF $^{185}Re(n,\gamma)^{186}Re$ NUCLEAR PROCESSES IN $K_2ReBr_6-K_2OsCl_6$ IN MIXED CRYSTALS. Mueller, Horst (Univ., Freiburg i. B.). J. Inorg. Nucl. Chem., 29: 2167-71(Sept. 1967). (In German).

All mixed hexa(bromochloro)rhenates, $^{186}ReBr_n\,Cl_{6-n}^{2-}$ $(0 \le n \le 6)$, are produced in mixed crystals $K_2ReBr_6-K_2OsCl_6$ by the nuclear process $^{185}Re(n,\gamma)^{186}Re$. Because of the small amount of $^{186}ReCl_6^{2-}$ the billiard-ball process must be disregarded as a mechanism for the production of retention. Reaction zone and recoil range are noticeably smaller than for the system $K_2ReBr_6-K_2SnCl_6$ investigated previously. The Szilard–Chalmers properties of solid K_2ReBr_6 are influenced by homogeneous dilution with K_2OsCl_6 less than by dilution with K_2SnCl_6. The differences in the proportions of the respective recoil products for both mixed-crystal systems are a further argument against the hot-spot model. (auth) (UK)

45158 RADIATION-INDUCED REACTIONS WITH CELLULOSE. IV. ELECTRON PARAMAGNETIC RESONANCE STUDIES OF RADICAL FORMATION. Dilli, S.; Ernst, I. T.; Garnett, J. L. (Univ. of New South Wales, Kensington). Aust. J. Chem., 20: 911-27(May 1967).

The radioinduced formation of trapped radicals in cellulose, both in vacuum and air, was studied by EPR spectroscopy. Factors affecting radical concentration were examined, including total dose, dose rate, heat, cellulose pretreatment, and kinetics of radical decay. All spectra were asymmetric in shape. Variables affecting line shape were studied, including oxygen, irradiation conditions such as the presence of water, acetic acid, copper sulfate solution, methanol, ethanol, potassium iodide, and liquid ammonia. The data indicate that the observed cellulose EPR spectrum is composed of an overlapping singlet with a triplet. Studies of radical decay show that a significant concentration of EPR species still remains in irradiated cellulose after 4 years at ambient temperature. (auth)

45159 DEGRADATION AND BRANCHING OF POLY(VINYL ACETATE) IN SOLUTION BY THE ACTION OF ^{60}Co γ RADIATION. Schnabel, Wolfram; Schamberg, Eckehard (Hahn-Meitner-Institut fuer Kernforschung, Berlin-Wannsee, Ger.). Makromol. Chem., 104: 9-17(1967). (In German).

Linear poly(vinyl acetate) having an approximately random molecular weight distribution was γ-irradiated in acetone solution at various concentrations. It was shown by light scattering and viscosity measurements that at concentrations below the critical concentration for gel formation the polymer is crosslinked to a certain extent in addition to the predominant degradation of the main chain. In accordance with the previously developed theory of simultaneous crosslinking and degradation, the ratio of the sp degradation and crosslinking densities (P_0Q_0) increases with decreasing polymer concentration and surpasses the value 2 at the critical concentration. (BBB)

45160 POLYMERIZATION IN THE SOLID STATE AT HIGH PRESSURE. 3. INFLUENCE OF HIGH PRESSURE ON THE RADIOCHEMICAL POLYMERIZATION OF DIKETENE. Suzuki, T.; Tabata, Y.; Oshima, K. (Tokyo Univ.). Makromol. Chem., 104: 236-43(1967). (In German).

Effects of pressure on radioinduced ring-opening polymerization of diketene in the solid state were investigated at 1 and 5000 kg/cm^2. Three series of tests were carried out, at −13, −78, and −196°C at a dose rate of 1.3×10^4 R/hr with ^{60}Co γ radiation. The monomeric diketene was submitted to pressure applied both before and during radioinduced polymerization. Polymerization reactivity was substantially elevated by applying high pressure while the reactivity under normal pressure was decreased by pretreatment under high pressure. Furthermore, it was confirmed that vinyl polymerization can proceed also in the solid state to some extent, and that this reaction is suppressed by high pressure. (BBB)

45161 RADIATION CHLORINATION OF KEROSENE. Dzhagatspanyan, R. V.; Lyaskin, Yu. G.; Filippov, M. T.; Sinitsin, V. I.; Yakimenko, L. M.; Glebova, L. I.; Zetkin, V. I. Khim. Prom., No. 5, 338-40(May 1966). (In Russian).

Data were obtained for the chlorination of paraffinic hydrocarbon mixtures in the presence of γ radiation from a ^{60}Co source. Results are given for temperatures between 20 and 60°C and dose rates between 0.81 and 26.1 RAD/sec; at the maximum rate and temperature, 60% conversion was obtained in 30 min. A linear correlation was obtained between log G and dose rate at 20° for several different stages of chlorination. Log K, where K is the pre-exponential term for G, is a linear function of the Cl content of the mixture. Results are compared with those of chlorinations induced photochemically and by azobisisobutyronitrile. Results indicate that desired products are obtained much more quickly by radiation chlorination than by the other routes. (BBB)

45162 ACTION OF GAMMA RADIATION ON POLYTETRAFLUOROETHYLENE. Ferse, A.; Koch, W.; Wuckel, L. (Inst. fuer Silikonund Fluorkarbonchemie, Radebeul-Dresden, Ger.). Kolloid-Zh., 219: 20-9(July 1967). (In German).

Effects of ^{60}Co γ radiation on some physical properties of poly(tetrafluoroethylene) (PTFE) resin, using 4 different preparations of PTFE having diverse qualities, were estimated. The range of irradiation dose was between 10^3 and 10^8 R. The melting point of the polymer, which was determined by differential thermal analysis, decreased with increasing irradiation doses. Chain scission was estimated by density changes. The chain length decreased after irradiation in air with 5×10^5 R to one-tenth the starting value. After passing a maximum, elongation at break decreased during irradiation following a hyperbolic function. Tensile strength decreased with increasing irradiation doses up to 10^5 R. Higher doses did not influence the tensile strength values. Decomposition of the PTFE in the presence of air took place faster than in vacuo, as evident from the more favorable elongations at break and tensile strengths, in contrast to the samples irradiated in air, and from the dependence of the density on

irradiation dose. G values for chain scission during irradiation in air and in vacuo were estimated. (BBB)

45163 A STUDY OF ^{51}Cr RETENTION AND ANNEALING IN SINGLE CRYSTALS OF K_2CrO_4 IRRADIATED AT LOW NEUTRON DOSES. Guetlich, Phillip; Harbottle, Garman (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. Radiochim. Acta, 8: 30-3(Sept. 1967). (BNL-10901).

The retention and isochronal annealing of ^{51}Cr-labeled species generated by thermal neutron capture in single crystals of K_2CrO_4 were investigated at very low dose levels. The crystals were bombarded at liquid nitrogen temperature. Although the "no-annealing" retentions agreed with existing data, some new fine structure appeared in the annealing curves. (auth)

45164 REACTOR PRODUCTION OF CARRIER-FREE ^{54}Mn FROM NATURAL IRON OXIDE. Barrachina, M.; Villar, M. A. (Junta de Energia Nuclear, Madrid). Radiochim. Acta, 8: 23-7(Sept. 1967).

A radiochemical procedure was worked out to prepare carrier-free ^{54}Mn from neutron-irradiated ferric oxide of natural isotopic abundance. The procedure was designed to process large-size targets, 120 g, of especially purified ferric oxide. Target-iron was separated to better than 99.8% by a single batch extraction of its tetrachloroferric acid into diisopropyl ether. Residual iron was removed by a hydrochloric acid-anion exchange chromatographic step. The ^{54}Mn recovery yield of this procedure was over 98%. The main characteristics of the ^{54}Mn solution obtained are: specific activity ≃300 Ci/g Mn; radioactive density ≈5 mCi/g solution; total iron decontamination factor $>5 \cdot 10^6$; and ^{51}Cr decontamination factor $\simeq 10^4$. (auth)

45165 ANNEALING OF CHEMICAL RADIATION DAMAGE IN POTASSIUM BROMATE BY COMPRESSION. Khare, M.; Mohanty, S. R. (Banaras Hindu Univ., India). Radiochim. Acta, 8: 63-4(Sept. 1967).

Compression of gamma-irradiated potassium bromate crystals resulted in considerable direct recovery of the damage. The fraction φ of initial damage (1629 ppM of oxidizing fragments) recovered by 25 ton in.$^{-2}$ was 0.326. The φ-log P plot was linear with an intercept on the P axis, which indicates the existence of a threshold pressure for annealing (2.25 ton in.$^{-2}$). Merely crushing the irradiated crystals also resulted in direct recovery to the extent of $\varphi = 0.204$. Compression and crushing also rendered the material more susceptible to thermal annealing. (M.C.G.)

45166 THE ROLE OF VARIOUS INORGANIC SOLID ADDITIVES IN RADIATION-INDUCED SOLID-STATE POLYMERIZATION OF 3,3-BIS-CHLOROMETHYLOXETANE. Kagiya, Tsutomu; Izu, Masatsugu; Fukui, Kenichi (Kyoto Univ.). Makromol. Chem., 102: 39-46(1967).

The effects of a large variety of solid additives on the γ radio-induced polymerization of 3,3-bis(chloromethyl)oxetane were studied. Some of the additives that accelerated the polymerization rate of the unpurified monomer showed no effect with the purified monomer. The results obtained with the pure monomer showed that the number of polymer chains under the same conditions was independent of the kind of solid additive, and was constant; and the rate of polymerization and the intrinsic viscosity of the polymer increased with irradiation dose. It was concluded that the additive acted by depressing a termination reaction by trapping the poison for polymerization. It was apparent that all the catalytic additives were strongly basic. Since the basicity corresponds to low ionization potential, the catalytic additives had marked ability to form a cation upon γ irradiation. Accordingly, it was considered that the total concentration of cation in the polymerizing system was larger in the presence of the catalytic additive than in its absence. (BBB)

45167 ANNEALING BEHAVIOUR OF SOME SALTS OF TRISETHYLENEDIAMINE COBALT III. Dimotakis, P. N. (Democritos Nuclear Research Center, Athens); Maddock, A. G.; Vassos, B. Radiochim. Acta, 8: 38-41(Sept. 1967).

The sensitivity to radiation and thermal annealing of a number of salts of the trisethylenediamine cobalt(III) cation were compared with their retentions when neutron irradiated under the same conditions. No simple relation between these quantities was found. The effect of dehydrating the irradiated hydrated chloride was to produce almost complete retention. (auth)

45168 EFFECT OF IONIZING RADIATION AND PLASTIC DEFORMATION ON THE MICROHARDNESS OF POTASSIUM BROMIDE CRYSTALS. Damm, J. Z.; Suszynska, M. (Inst. of Low Temperature and Structure Research, Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci. Chim., 15: 313-17(1967).

The effects of ionizing radiation on the microhardness of potassium bromide crystals was studied, and the occurrence of radio-induced secondary effects resembling those of ordinary plastic deformation reported. The soft ionizing radiation (nonfiltered x rays) induced nonuniform distribution of color centers and the microhardness rapidly increased from the very beginning of irradiation to attain values higher than the initial by 20 to 30%. Hard radiation induced uniform coloration of the KBr crystals and after a rather short irradiation corresponding to the rapid growth of F-centers in the initial coloration stage, the microhardness maximum was observed. Comparison was made of the microhardness curves for plastically deformed crystals of KBr and those for KBr exposed to hard ionizing radiation. (D.H.M.)

45169 SEPARATION OF RECOILING CHROMIUM(II) SPECIES FROM NEUTRON-IRRADIATED HEXAQUOCHROMIUM(III) ION ADSORBED ON ION-EXCHANGER. Matsuura, Tatsuo; Sasaki, Takashi (Rikkyo Univ., Yokosuka, Japan). Radiochim. Acta, 8: 33-7(Sept. 1967).

Continuous extraction of the ^{51}Cr-enriched chromous species during neutron-irradiation of hexaquochromium ion adsorbed on a cation-exchange resin was carried out with oxalic acid and other eluents, and this dynamic method gave higher yields and enrichment factors than the static irradiation method. Dynamic irradiations at controlled temperatures were also performed for the first time and the effects of irradiation temperature and of bead radius on the separable yield and the enrichment factor were studied. As expected, the enrichment factor increased with decreasing irradiation temperature. The inherent yield, which was estimated from extrapolation to zero bead radius, increased with increasing irradiation temperature, and this result could be interpreted on the hypothesis that thermodynamical equilibrium is established at the end of hot reaction in the recoil process. (auth)

45170 RADIOLYSIS OF COMPOUNDS OF NOBLE METALS IN AQUEOUS SOLUTIONS. IV. GAMMA RADIOLYSIS OF CONCENTRATED SOLUTIONS OF PLATINUM. Haissinsky, Moise; Pobedimsky, G. R. (Laboratoire Curie, Paris). J. Chim. Phys., 64: 1128-32(July-Aug. 1967). (In French).

The oxidation of $PtCl_4^{2-}$ by Rd–Co γ rays in concentrated solution followed approximately the kinetics previously observed for dilute solutions; in aerated solution, however, where the rate of oxidation was mostly determined by the oxygen diffusion, the yields were very much smaller. When the concentration of Pt-II reached circa 10^{-3}M metallic Pt was formed with a yield that varied with the concentration of the solute according to a dilution curve. At the plateau $G(Pt^0)$ was 0.11 in aerated solution, 0.135 in degassed solution. The temperature effect on the yield was also examined. The origin of this formation was attributed to the subexcitation electrons. (auth)

45171 NEW ISOTOPE LIVES LONGER. New Sci., 35: 598(Sept. 21, 1967).

Discovery of a new isotope of mendelevium, ^{258}Md, was recently announced by G. T. Seaborg. It was obtained at University of California, Berkeley, using the heavy ion linear accelerator, by bombardment of einsteinium with He-ions. It has a half-life of about 2 months, which is unusually long for this region of the periodic table. The length of its half-life has some important implications, both theoretical and practical. It decays by alpha emission to ^{254}Es. The predicted half-life is of the order of 10 hours, but the nuclide is in the "hindered" category. Having 101 protons and 157 neutrons it falls into the odd-odd class, and since the hindrance factor might be as much as a thousand, this may account for its long half-life. (UK)

45172 RADIOCHEMICAL PROCESSES IN IRIDIUM COMPLEXES. IV. REDUCTION REACTIONS IN THE CRYSTALS. Cabral, J. M. Peixoto; Maddock, A. G. (Junta de Energia Nuclear, Sacavem, Portugal). J. Inorg. Nucl. Chem., 29: 1825-36(Aug. 1967).

A comparison is reported between the products formed by the (n,γ) reaction in hydrated and anhydrous sodium hexachloroiridate (IV), as well as in the ammonium salt. The effects of hydration and dehydration after neutron irradiation are also described. Results showed that both water of hydration and ammonium ions led to the survival of a smaller proportion of *Ir(IV) species. With the ammonium salt some unidentified chloroammine complexes of Ir(III) were produced. In the hydrated salts the iridium fragments contained a smaller average number of attached chlorine atoms than in the anhydrous salts. During hydration and dehydration annealing reactions, leading to an increase in *Ir(IV) products, outweighed other effects. These observations are interpreted in terms of a model based on donor-trap electron transfer reactions in the solid. (auth) (UK)

45173 POLYMERIZATIONS IN THE GLASSY STATE. Chapiro, A. (CNRS, Bellevue, France). Chimia (Aarau), 21: 454-9 (Sept. 15, 1967). (In French).

Numerous vinyl monomers polymerize rapidly when irradiated

at low temperature (−78 to −196°C) in vitreous mixtures with oils, polymers, or certain solvents. The kinetic features of all these reactions are similar: very high conversions can be reached; polymerization rates and molecular weights exhibit a maximum for diluted monomer solutions. The polymerization proceeds by a free-radical mechanism in hydrocarbon media; it may be anionic if the solvent used is an amide or an amine, or cationic in a halogenated compound. The structure of the binary glasses was investigated and it was found that phase separation occurs at low temperature, the monomer being dispersed in little droplets embedded in the vitreous medium. The polymerization occurred in these droplets, which may remain in a supercooled state, at temperatures as much as 80°C below the normal melting point of the monomer. When the mixtures were irradiated at temperatures below the glass transition point of the monomer, a polymerization was observed that may still proceed very rapidly. This reaction occurred at a temperature very close to the transition point in a highly viscous medium in which chain termination was strongly reduced. (auth)

45174 RADIATION-INDUCED SOLID-STATE POLYMERIZATION IN BINARY SYSTEMS. IV. SOLID-STATE POLYMERIZATION IN THE GLASSY PHASE. **Kaetsu, Isao; Tsuji, Kozo; Hayashi, Koichiro; Okamura, Seizo (Kyoto Univ.). J. Polym. Sci., Part A-1, 5: 1899-1909(Aug. 1967).**

The radioinduced polymerization of glass-forming systems containing monomers was investigated. It was found that irradiation below the second-order transition temperature T_g of the systems causes no in-source polymerization but causes a rapid postpolymerization on warming above the T_g after initial irradiation below the T_g. The post-polymerization was followed by differential thermal analysis and ESR spectral analysis. It is caused above the T_g by the release of peroxy radicals trapped below the T_g, and its rate is proportional to the irradiation dose to some extent, often is explosively high, and brings about a remarkably large temperature rise by accumulation of polymerization heat. Irradiation above the T_g causes rapid in-source polymerization which is accelerated by the high viscosity of the monomeric system between T_g and T_s (WLF temperature) compared to crystal or ordinary solution polymerization. The temperature dependence of the in-source polymerization of glassy systems shows a peak between the T_g and T_s which may be the result of competing effects of the rate increase by the decreased termination near T_s and the rate decrease by the decreased propagation caused by the diffusion prevented near the T_g. The degree of polymerization was also investigated. The temperature dependence of the degree of polymerization of the polymers obtained by in-source polymerization shows a peak similar to that of the temperature dependence of conversion. Unusually large values of the Huggins constant k′ are noted between T_g and T_s. The degree of polymerization of the polymer obtained by post-polymerized increases with the increase of irradiation dose and the polymerization rate; this may be the result of decreased chain transfer to nonpolymerizable components. (auth)

45175 QUANTITATIVE DETERMINATION OF SHORT BRANCHES IN HIGH-PRESSURE POLYETHYLENE BY GAMMA RADIOLYSIS. **Kamath, Pandurang M.; Barlow, Anthony (U. S. Industrial Chemicals Co., Cincinnati). J. Polym. Sci., Part A-1, 5: 2023-30(Aug. 1967).**

Studies on the radiolysis products of a series of ethylene α-olefin copolymers and ethylene homopolymers showed that if a correction is applied, to take into account the fragments arising from scission at chain ends, the remaining products can be quantitatively accounted for as entirely due to scission of side branches introduced onto the backbone chain by the α-olefin comonomer. The cleavage of branches takes place, for all practical purposes, exclusively at the branch points at which the branches are attached to the backbone chain. The same data together with similar radiolysis data of poly(3-methyl pentene-1) and poly(4-methyl pentene-1) showed that all branches cleave with equal efficiency, regardless of their length. Radiolysis does, therefore, provide a reliable and convenient tool for the quantitative characterization of high-pressure polyethylene with regard to the unique short-chain branching distribution that is characteristic of each. (auth)

45176 ESR STUDY OF RADICALS TRAPPED IN AMORPHOUS AND CRYSTALLINE SAMPLES OF POLY(ETHYLENE TEREPHTHALATE) AFTER γ-IRRADIATION. **Campbell, D.; Turner, D. T. (Research Triangle Inst., Research Triangle Park, N. C.). J. Polym. Sci., Part A-1, 5: 2199-2201(Aug. 1967).**

Samples of amorphous and crystalline poly(ethylene terephthalate), PET, were sealed in a quartz tube, irradiated in a ^{60}Co γ-source, and flame-annealed. ESR studies resulted in quite different spectra for the amorphous and crystalline samples. The spectrum obtained from the polycrystalline sample is complex due to the lack of preferred orientation of the radicals. An explanation is offered for variations in radical stability, although the findings are not conclusive. Results of this and similar studies seem to imply that the radiation chemistry of a polymer may be strongly influenced by its physical state. (J.G.B.)

45177 A NEW KIND OF ASYMMETRIC SYNTHESIS. THE RADIATION POLYMERIZATION OF TRANS-1,3-PENTADIENE INCLUDED IN OPTICALLY ACTIVE PERHYDROTRIPHENYLENE. **Farina, Mario; Audisio, Guido; Natta, Giulio (CNR, Milan). J. Amer. Chem. Soc., 89: 5071(Sept. 13, 1967).**

An isotactic polymer in the solid state, trans-1,4-polypentadiene, was synthesized by γ-irradiation of PHTP (trans, anti, trans, anti, transperhydrotriphenylene) inclusion compounds with trans-1,3-pentadiene. The polymer showed an unambiguous optical activity of sign opposite to that of PHTP: $[\alpha]_D^{25} + 2.5 \pm 0.3$ ($CHCl_3$) (Perkin-Elmer 141 polarimeter). At shorter wavelengths the rotary power increased considerably $[\alpha]_{436}^{25} + 6.4°$, $[\alpha]_{365}^{25} + 9.8°$. Present investigations are underway to determine whether polymerization starts from asymmetric radicals or ions obtained by irradiation of PHTP, or if it exclusively involves the guest molecules. (D.H.M.)

45178 MODIFICATION OF WOOD AND PAPER PROPERTIES BY $^{10}B(n,\alpha)^7Li$ INITIATED GRAFT COPOLYMERIZATION. **Loos, Wesley Emil. Raleigh, N. C., North Carolina State Univ., 1966. 107p.**

Thesis.

The homopolymerization of vinyl monomers initiated by the B(n,α)Li reaction was demonstrated. Specifically acrylonitrile and methyl methacrylate were polymerized by this method of initiation. The thermal neutrons were from the thermal column of the North Carolina State University 10-Kw heterogeneous swimming pool type reactor. Radiation kinetic and G-values were calculated for these homopolymerization reactions. The dose-rate exponent was calculated to be 0.57 for acrylonitrile in dilute dimethylformamide solution. This is very close to the result (0.55) calculated using gamma rays. The G-value for chains initiated by the B(n,α)Li reaction was found to be 1.5 as compared to 2.8 for gamma radiation, indicating somewhat lower efficiency for the former form of initiation. The effects of oxygen inhibition, solvent transfer, monomer concentration, and inhibiting factors on polymer yield were also studied. Graft copolymerization of vinyl monomers onto cellulosic substrates such as paper and wood was initiated by the B(n,α)Li reaction. Proof of true grafting was established by the controlled extraction of homopolymer under heat and vacuum with DMF. Paper had a fairly large amount of homopolymer produced as indicated by the losses in weight after extraction. In most cases the weight increase in wood was largely graft copolymer as indicated by the extraction data. Grafting efficiency of this method of initiation was compared with the efficiency of γ ray initiation. The neutron–boron initiation technique is only 40 to 50% as efficient as γ initiation for acrylonitrile onto both wood and paper. It was substantiated that thermal neutrons did not damage cellulosic substrates. With boron present the radiation from the B(n,α)Li reaction did damage the substrate with or without "grafting." This was determined from tests of the breaking and fold strength of paper specimens as well as toughness and abrasion resistance of wood specimens. The substrate degradation was approximately the same as that measured for the comparative γ-ray initiated graft copolymers. The graft copolymers produced had some improved physical and mechanical properties over those of the substrate materials. For example, acrylonitrile graft onto paper produced superior wet and dry tensile strength. In fact the wet strength was increased 10 fold for a 50% weight increase. Acrylonitrile–wood copolymers showed improved abrasion resistance and some dimensional stability to moisture changes. This was especially true if "grafting" was done on pre-swollen substrates. (Disser. Abst.)

45179 GAMMA-RAY-INDUCED RECOMBINATION OF HYDROGEN AND OXYGEN IN THE PRESENCE OF WATER VAPOR. **Su, Albert Yung-sung. Minneapolis, Univ. of Minnesota, 1963. 165p.**

Thesis.

A γ-induced recombination reaction of hydrogen and oxygen in the presence of large amounts of water vapor was carried out under room temperature and nearly saturated conditions. A mixture of hydrogen and oxygen with amounts less than one micromole was analyzed by gas chromatography. Ethylene was used as the gas dosimeter. The reaction rate was found proportional to the water vapor pressure and hydrogen partial pressure, but inversely proportional to the oxygen partial pressure and surface–volume ratio. Furthermore, the reaction rate was found dependent on the exposure or absorbed dose rate to an order of 2.4. Water is believed to be the main product and hydrogen peroxide may be

present in small amounts. For the conditions studied, a constant reaction rate was found throughout the reaction path. An empirical rate equation was obtained and an overall rate constant was calculated for all runs with a probable deviation of ten percent. A reaction mechanism is proposed as a basis for further study. The mechanism is compatible with the empirical rate equation and most experimental observations. The value for $G(-H_2)$ was found to be about 4 to 6 for most runs. It increases with increasing exposure dose rate and pressure of hydrogen and decreases with increasing pressure of oxygen. (Disser. Abst.)

45180 STUDY OF THE RADIATION CHEMISTRY OF AQUEOUS CYSTEINE SOLUTIONS. Festa, John Lucian. Durham, N. H., Univ. of New Hampshire, 1967. 59p.
Thesis.

Dilute aqueous solutions of cysteine were irradiated with gamma rays from a ^{60}Co source. Radiolytic yields (G values) were determined for the disappearance of cysteine and for the formation of hydrogen, hydrogen sulfide, and hydrogen peroxide in both deaerated and oxygenated solutions. In the absence of air the yield of thiol loss was found to be dependent on pH and on the initial thiol concentration, while in the presence of oxygen the yield was sensitive to both the initial thiol and oxygen concentrations. Oxygen reduced the yields of both hydrogen and hydrogen sulfide, but enhanced the yield of hydrogen peroxide. The effects of various solutes on the rate of thiol destruction in the irradiated solutions were investigated. The results obtained indicate that cysteine can react quite readily with the intermediates produced by the radiolysis of water. Complete mechanisms were postulated for the radio-induced decomposition of cysteine in the deaerated and oxygenated solutions. In addition, a possible explanation is given for the mechanism of radiation protection of biological systems by cysteine. (Disser. Abstr.)

45181 CATALOGUE OF RADIOACTIVE PRODUCTS 1967/68. Amersham, Eng., United Kingdom Atomic Energy Authority, 1967. 215p.

Details are given on the ordering, distribution, packaging, delivery, insurance, prices and payment, and licensing and registration procedures for radioactive products. The catalog covers radioisotopes and labeled compounds, medical products, radiation sources, material for instrument calibration, and general services. (UK)

45182 POLYMERIZATION METHOD FOR CYCLIC ETHERS IN THE PRESENCE OF MALEIC ANHYDRIDE OR ITS HALIDE DERIVATIVES. (to Japanese Association for Radiation Research on Polymers). British Patent 1,085,805. Oct. 4, 1967. Priority date Nov. 8, 1963, Japan.

A method of producing a polymer and copolymer of polyether is described. Polymerization of cyclic ether in the presence of maleic anhydride or its halide derivatives is carried out by irradiation with ionizing or ultraviolet radiations or by the action of a free radical polymerization initiator, such as benzoyl peroxide. The polymers thus obtained consist mainly of polyether and in some instances contain a small amount of maleic anhydride in the chain and/or the terminal unit of the molecule. (J.G.B.)

45183 PROCESS OF ISOTOPIC ENRICHMENT BY DUAL TEMPERATURE EXCHANGE NH_3–H_2. (to Commissariat a l'Energie Atomique). British Patent 1,084,940. Sept. 27, 1967. Priority date June 30, 1965, France.

A process of isotopic enrichment of hydrogen by deuterium by counter-current isotopic exchange between liquid ammonia and gaseous hydrogen in two exchange zones at different temperatures is described. The exchange reaction consists of contacting gaseous hydrogen with a solution in liquid ammonia of an ether and an alkali metal amide catalyst. (D.H.M.)

Radiochemistry

Refer also to abstract 45014.

45184 RADIOACTIVITY BUILD-UP OF FRESHLY SEPARATED RADIUM FROM THE URANIUM, ACTINIUM, AND THORIUM SERIES. Uken, E. A.; Williamson, J. E. (National Inst. for Metallurgy, Johannesburg. Union Corp. Mines Research Lab., Springs, S. Africa). Radiochim. Acta, 8: 60-3(Sept. 1967).

Calculations borne out by experiment show that freshly separated isotopes of radium from the uranium, actinium, and thorium series recover at different rates. Slope measurements are used to determine the initial concentration of radium, as well as its origin. The "Thorium Constant Count Technique" yields results that lie within the permissible limits of beta counting. (auth)

45185 INFLUENCE OF THE PHASE ON THE CHEMICAL BEHAVIOR OF ^{132}I FORMED BY THE DISINTEGRATION OF ^{132}Te IN ORGANIC MEDIUM. III. DIBUTYLTELLURIUM $(C_4H_9)_2$ ^{132}Te IN THE PURE STATE AND IN SOLUTION IN BENZENE. Llabador, Yvan; Adloff, J. P. (Centre de Recherches Nucleaires, Strasbourg). Radiochim. Acta, 8: 41-3(Sept. 1967). (In French).

The organic yields of ^{132}I formed during disintegration of ^{132}Te in dibutyltellurium in the pure form and its solution in benzene were measured as a function of the concentration, both in the liquid and solid state. Important phase effects were observed and the results are justified on the basis of the autoirradiation model. (auth)

45186 TRANSIENT ANNEALING OF ISOMERIC TRANSITION RECOILS IN SODIUM BROMATE. Jones, C. H. W. (Simon Fraser Univ., Burnaby, British Columbia). Inorg. Nucl. Chem. Lett., 3: 363-7(Sept. 1967).

Studies were made to ascertain whether annealing could be observed by heating the crystals following the growth of ^{80}Br into equilibrium with the ^{80m}Br. Results indicated that isomeric transition recoils in this lattice are very sensitive to thermal annealing. The observed decrease in retention for longer heating times apparently derives from the finite lifetime of defects and annealed recoils in the lattice. The theory advanced explains why other workers failed to observe appreciable annealing. Perhaps the most significant observation is that recoil annealing occurs so rapidly in this system, retention increasing from 28.5% to 75.5% in 5 min. at 245°C. This is a much more rapid process than that observed for (n,γ) recoils produced in sodium bromate on gamma irradiation. This suggests that recoil annealing is suppressed by very low doses of gamma radiation and that, in the complete absence of such radiation, as in isomeric transition, the annealing reaction proceeds very rapidly to yield large changes in retention. (UK)

45187 TRITII V ORGANICHESKOI KHIMII. (Tritium in Organic Chemistry). Gusev, G. G.; Kapustin, Yu. M. Moscow, Atomizdat, 1966. 80p.

A brief description is given of the properties, nomenclature, and characteristics of tritium-containing organic compounds. Preparation of tritiated organic compounds, radiation stability, and radiochemical stability of tritium are discussed. Industrial and experimental applications of the tritium isotope and safety techniques in handling of radioactive materials are also discussed. (254 references) (R.V.J.)

Separation Processes

Refer also to abstracts 45005, 45031, 45068, 45082, 45085–45087, 45100, 45169, 45880, 46863, and 47050.

45188 (AAEC/E-175) ECONOMICS OF THE H.T.G.C.R. FUEL CYCLE. PART 1. PRE-DESIGN COST STUDY OF FUEL CYCLE FACILITY. May, J. R.; Devine, J. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). May 1967. 47p. Dep.

A conceptual design study of a facility to recycle fuel from a beryllium oxide-moderated high-temperature gas-cooled pebble-bed reactor was made. For a facility to handle 300 kg of fuel per day, the capital cost is estimated as $A30 millions and the annual direct operating cost, excluding capital charges, as $A3.1 millions. (auth)

45189 (AAEC/E-180) LABORATORY DEVELOPMENT OF THE GRIND-LEACH PROCESS FOR THE H.T.G.C.R. FUEL CYCLE. PART 4. LEACHING AND DISSOLUTION OF BERYLLIA BASED FUELS. Shying, M. E.; Lee, E. J.; Farrell, M. S. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). July 1967. 31p. Dep.

The chemical development of an acid-leach head-end process for the separation of $(U,Th)O_2$ from a beryllia matrix is described. The work is related to a feasibility study of the H.G.T.C.R. fuel cycle. Although more than 99 per cent of the actinides can be recovered in a single batch nitric acid leach, more than 30 per cent of the beryllia is dissolved. When it was found that sulfuric acid selectively dissolved the beryllia, a two-step process using nitric and sulfuric acids in sequence was developed, with recycling of the actinide-rich heel to the next batch. Preliminary results from multi-batch experiments indicate that it might be possible to decrease the beryllia loss to the nitrate stream to 10 per cent and still recover 99 per cent of the actinides. Further development of the process would involve the use of proven reactor material irradiated to high burnup. Suggestions for further research are given. (auth)

45190 (ANL-7325) CHEMICAL ENGINEERING DIVISION SEMIANNUAL REPORT, JULY–DECEMBER 1966. (Argonne National Lab., Ill.). Apr. 1967. Contract W-31-109-eng-38. 203p. Dep. CFSTI.

Seven sections are included; separate abstracts were prepared for each. (P.C.H.)

For abstracts of individual sections see: 45005, 45068, 45069, 45191, 45192, 46683, and 46837.

45191 (ANL–7325, pp 19–49) COMPACT PYROCHEMICAL PROCESSES. (Argonne National Lab., Ill.).

Developments are reported for studies on: conceptual pyrochemical process for fast reactor fuels; distribution of elements between liquid alloys and molten salts; distribution of U between Cu–Mg alloy and molten $MgCl_2$; distribution of U between 50 mole % $MgCl_2$–30 mole % NaCl–20 mole % KCl salt and Zn–Mg; distribution of Zr between $MgCl_2$ and Cu–Mg alloy; distribution of Th between molten $MgCl_2$–NaCl–KCl and liquid Mg alloys; solubility of U in Zn–Mg; solubility of U in the U–Cd–Zn system at low zinc concentrations; chemical interactions of uranium oxides with molten salts; salt transport separations; extraction columns; salt pump loop; materials testing; containment of Cu–Mg–U/halide salt systems; containment of Zn–Mg–U/halide salt systems; skull reclamation process; skull oxide reduction furnace; recovery of U product by retorting; removal of U from metal crucible by hydriding; absorption of molten salts by Fiberfrax; fuel cycle facility operations; processing irradiated fuel by melt refining; reclamation of fuel alloy scrap present in crushed glass molds from injection casting operations; behavior of Mark IA fuel; variation of swelling rate with process operations; and maintenance of electromechanical manipulators and in-cell cranes. (P.C.H.)

45192 (ANL–7325, pp 50–98) FLUIDIZATION AND VOLATILITY PROCESSES. Jonke, A. A.; Barghusen, J. J. (Argonne National Lab., Ill.).

Developments are reported for studies on: fluorination of UO_2–PuO_2–fission product pellets in a 2-in. diameter reactor; leaching of alumina beds for plutonium recovery; fluorination of UO_2–PuO_2–fission product pellets with fluorine and BrF_5; fluorination of UO_2–PuO_2–fission product pellets in the presence of added Cs, Rb, and Np; rate of U_3O_8 fluorination with BrF_5; Pu material balances; fluorination of uranium compounds by BrF_5; tellurium fluoride chemistry; instrumental analysis; neptunium fluoride chemistry, corrosion of Ni and Ni alloys by fluorides; an equation for predicting thermal decomposition of PuF_6 in process gas mixtures of PuF_6 and F_2; recovery of U and Pu from UO_2 fuels in the engineering-scale alpha facility; effects of process variables on fluorination of UO_2 fuels by BrF_5; cleanup of cell exhaust air contaminated with plutonium hexafluoride; bench-scale fluid-bed studies with irradiated fuels; disposal of gaseous fluoride volatility reagents; relation of fluidized-bed behavior to process operations; and mechanism of heat transfer between a fluidized bed and the reactor wall. (P.C.H.)

45193 (BNWL-460) RADIOIODINE CONTROL DURING REPROCESSING OF SHORT-COOLED IRRADIATED ^{237}Np ALUMINUM ALLOY TARGET ELEMENTS (A PRELIMINARY STUDY). Greenhalgh, W. O. (Battelle-Northwest, Richland. Wash. Pacific Northwest Lab.). Apr. 1967. Contract AT(45-1)-1830. 13p. Dep. CFSTI.

The chemistry of radioiodine was studied in the following process steps: dissolution of the Np–Al target in nitric acid with mercury catalyst and subsequent feed stream manipulation and storage; extraction of neptunium and plutonium by 30% TBP–NPH (normal paraffin hydrocarbon); and absorption of neptunium and plutonium by Dowex 1 anion resin. Two percent or less of the total radioiodine was evolved during dissolution tests using an aluminum metal stand-in. Almost quantitative extraction of the feed stream radioiodine was exhibited by a 30% TBP-NPH batch contact. Greater than 90% of the feed stream radioiodine was absorbed by anion resin during one short column pass. Two methods (precipitation as mercuric iodide and extraction by phenyl mercuric acetate or phenyl mercuric nitrate in benzene) were found effective in removing feed stream radioiodine while only slightly affecting the neptunium content. (M.C.G.)

45194 (COO–499-16) TECHNICAL PROGRESS REPORT [ON INORGANIC CHEMISTRY]. Walton, Harold F. (Colorado Univ., Boulder). Sept. 11, 1967. Contract AT(11-1)-499. 5p. Dep. CFSTI.

The order of elution of aliphatic diamines from nickel-sulfonic resins by ammonia was determined. Ethyleneimine derivatives, ethanolamine derivatives, purine and pyrimidine bases, and polyhydric alcohols were separated by ligand-exchange liquid chromatography. Studies are also being made of ligand-exchange gas chromatography and thin-layer chromatography. Thermodynamic studies were made of univalent-divalent ion exchanges. (M.C.G.)

45195 (NYO–841-8) DYNAMIC ADSORPTION OF FISSION-PRODUCT NOBLE GASES ON ACTIVATED CHARCOAL. Underhill, Dwight W. (Harvard School of Public Health, Boston, Mass.). Apr. 1967. Contract AT(30-1)-841. 146p. Dep. CFSTI.

Since the ideal adsorption of fission gases is not observed, generally, because some of the fission gases pass through the bed long before saturation is approached, a study was made of the effect that these deviations from ideal behavior have on the efficiency of adsorption in charcoal beds. Experimental measurements were made of the adsorption and desorption of ^{85}Kr in an air carrier in charcoal beds cooled with dry ice. These measurements extended over a wide range of flow velocities and charcoal particle diameters; both coconut base and petroleum base charcoals were tested. From an analysis of the spreading of the fronts of ^{85}Kr passing through the beds, three mechanisms of mass transfer were found to be important. These are: diffusion in the mobile phase; axial dispersion; and stationary phase mass transfer resistance. Calculations applying mass transfer data to the design of fission gas adsorption beds are also given, with particular emphasis on the design of fission gas holdup beds. (P.C.H.)

45196 (NYO–841-9) SEPARATION OF ^{85}Kr FROM HYDROGEN BY SELECTIVE DIFFUSION THROUGH PALLADIUM–SILVER MEMBRANES. Underhill, Dwight W. (Harvard School of Public Health, Boston, Mass.). Apr. 1967. Contract AT(30-1)-841. 19p. Dep. CFSTI.

In a series of tests ranging from one-half hour to nine and one-half hours, diffused hydrogen was obtained from a hydrogen feed containing 4.0×10^{-2} μCi/(mL) of krypton-85. At no time during any of these tests was krypton-85 detected in the diffused hydrogen. The minimum separation factor, calculated from the ratio of the concentration of krypton-85 in the bleed stream to the minimum detectable concentration of krypton-85 in the diffused hydrogen, was at least greater than 10^5. In a subsequent test, a hydrogen-krypton-85 mixture was placed on one side of the diffusion membrane, and after 248 hours, the hydrogen on the other side of the barrier was drawn off and tested for the presence of krypton-85. The separation factor of the diffusion membrane, consistent with the absence of detected diffused krypton-85, is at least 3×10^{12}, showing the very high selectivity of the membrane. (auth)

45197 (NYO–3644-11) ION EXCHANGE RESINS: FOCUSED LASER DEGRADATIONS. Progress Report No. 2, September 1, 1966–August 30, 1967. Wiley, Richard H. (Hunter Coll., New York). Sept. 25, 1967. Contract AT(30-1)-3644. 4p. Dep. CFSTI.

Research on ion-exchange resins prepared from bead copolymers of styrene and divinylbenzene and on focused laser experiments to determine their plasma characteristics in chemical substances is described. (M.C.G.)

45198 (ORNL–4145) CHEMICAL TECHNOLOGY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING MAY 31, 1967. (Oak Ridge National Lab., Tenn.). Oct. 1967. Contract W-7405-eng-26. 327p. Dep. CFSTI.

Progress is reported under the following headings: power reactor fuel processing, fluoride-volatility processing, molten-salt reactor processing, waste treatment and disposal, transuranium element processing, development of the thorium fuel cycle, sol-gel processes for uranium fuel cycle, separations chemistry research, chemical applications of nuclear explosions, recovery of fission products by solvent extraction, biochemical separations, chemistry of protactinium, radiation effects on heterogeneous systems, spectrophotometric studies of solutions of alpha-active materials, chemical engineering research, reactor evaluation studies, preparation and properties of actinide oxides, assistance programs, chemistry of carbides and nitrides, industrial applications of nuclear energy, and safety studies of fuel transport. Separate abstracts were prepared for each of the 21 topics. (M.C.G.)

For abstracts of individual sections see: 45014, 45082–45084, 45144, 45199–45209, 45273, 45324, 45503, 45981, and 46863.

45199 (ORNL–4145, pp 29–57) POWER REACTOR FUEL PROCESSING. (Oak Ridge National Lab., Tenn.).

The development of mechanical processes for fuel processing is described. Burn-leach and grind-leach processes for graphite-base fuels are being investigated. A high-acid TBP extraction flow sheet was evaluated. Processes were also studied for heavy water-moderated organic-cooled reactor fuels and for fast breeder reactor fuels. (M.C.G.)

45200 (ORNL–4145, pp 58–94) FLUORIDE-VOLATILITY PROCESSING. (Oak Ridge National Lab., Tenn.).

Topics covered include: status of fluidized-bed volatility pilot plant, decladding and oxidation of Zircaloy-clad UO_2 fuels, particle size and filtration of U_3O_8 during oxidation,

effects of process variables of retention of uranium by alumina after treatment with fluorine, LiF and fluorine as a sorption-desorption system for PuF_6, fluorine calorimetric reactor for determining bromine and BrF_3 contents of primary reactor off-gas, sorption-desorption system for NpF_6, corrosion in volatility processes, leaching of uranium and plutonium from primary reactor waste solids, process flowsheet tests, sampling of solids from a fluidized-bed reactor, continuous in-line monitoring of process gas streams, and estimation of critical constants for NbF_5. (M.C.G.)

45201 (ORNL–4145, pp 95–103) MOLTEN-SALT REACTOR PROCESSING. (Oak Ridge National Lab., Tenn.).

Research is reported under the following headings: continuous fluorination of molten fluoride mixtures, corrosion control by use of a frozen wall, relative volatilities of rare earth fluorides in MSBR salts, vaporization rates in fluoride salt distillation, prevention of buildup of low-volatility materials at a vaporization surface, demonstration of fuel-salt distillation at the MSRE, alternative processing methods, and preparation of ^{233}U fuel for the MSRE. (M.C.G.)

45202 (ORNL–4145, pp 104–29) WASTE TREATMENT AND DISPOSAL. (Oak Ridge National Lab., Tenn.).

Methods for treatment and disposal of high-level, intermediate-level, and low-level radioactive waste are discussed and engineering, economic, and safety evaluations given. (M.C.G.)

45203 (ORNL–4145, pp 130–53) TRANSURANIUM ELEMENT PROCESSING. (Oak Ridge National Lab., Tenn.).

Operation of the transuranium processing plant, $^{242}PuO_2$ target irradiation in the High Flux Isotope Reactor, isolation of transplutonium elements from Tramex products, development of chemical processes, development of process equipment, and HFIR target rod failures are reported. (M.C.G.)

45204 (ORNL–4145, pp 154–79) DEVELOPMENT OF THE THORIUM FUEL CYCLE. (Oak Ridge National Lab., Tenn.).

A solvent-extraction process for preparing mixed ThO_2–UO_3 sols was developed and demonstrated in engineering equipment. Conditions were determined for producing ThC_2 microspheres at greater than 90% of theoretical density. A sphere-forming pilot plant was built and operated on the scale that will be required in the Thorium–Uranium Recycle Facility. The ^{233}U storage and distribution facility is described. (M.C.G.)

45205 (ORNL–4145, pp 208–33) SEPARATIONS CHEMISTRY RESEARCH. (Oak Ridge National Lab., Tenn.).

Progress in separations chemistry research is reported under the following headings: extraction of metal sulfates and nitrates by amines, new separations agents, selectivity of polyacrylamide gels for certain cations and anions, performance of degraded reagents and diluents, recovery of beryllium from ores, beryllium purification by solvent extraction, separation of zirconium and hafnium with amines, separation of rare earths, comparative chemistry of lanthanides and trivalent actinides, transplutonium element compound preparation and x-ray characterization, aminopolycarboxylic acid complexes of trivalent actinides, lanthanide and actinide sulfate complexes, equilibria and mechanisms of extractions, kinetics of metal-ion extraction by bis(2-ethylhexyl) ester of phosphoric acid, and aggregation and activity coefficients in solvent phases. (M.C.G.)

45206 (ORNL–4145, pp 240–2) RECOVERY OF FISSION PRODUCTS BY SOLVENT EXTRACTION. (Oak Ridge National Lab., Tenn.).

A process flowsheet for isolating fission-product rare earths, strontium, and cesium from Purex waste was demonstrated on a bench scale at tracer level. The rare earths and bulk metal contaminants were extracted from unadjusted waste solution with the sodium salt of di(2-ethylhexyl)-phosphoric acid, and the rare earths are selectively stripped from the extract. The raffinate from this operation was adjusted to a pH of about 6 to precipitate residual metal contaminants, and the resulting solution was contacted first with di(2-ethylhexyl)phosphate to recover strontium and then with a substituted phenol to recover cesium. The process yielded less-pure concentrates than processes developed previously, but it was simpler and did not require the use of large amounts of aqueous-phase complexing agents. (auth)

45207 (ORNL–4145, pp 269–74) CHEMICAL ENGINEERING RESEARCH. (Oak Ridge National Lab., Tenn.).

Performance of a prototype stacked-clone contactor with integral pumps, scaleup of the stacked-clone contactor, mass transfer of water from sol droplets during microsphere gelation, and hyperfiltration of spent sulfite liquor with a self-rejecting membrane are discussed. (M.C.G.)

45208 (ORNL–4145, pp 289–91) ASSISTANCE PROGRAMS. (Oak Ridge National Lab., Tenn.).

The Laboratory continued to coordinate the exchange of technical information between Eurochemic and the AEC production sites and national laboratories. Construction of the plant and its auxiliary facilities and startup operations are complete. Discharged fuels from several European reactors have now been processed. In a continuing program the radiation resistance of a number of protective coatings, lubricants, gasket materials, sealants, electrical insulation materials, and glasses were tested in a ^{60}Co gamma field having a radiation intensity of 8×10^5 R/hr. Epoxy and polyurethane coatings were satisfactory for total doses, in air, of up to 10^{10} RADs; failure of epoxy and modified phenolic coatings exposed in deionized water occurred at doses between 1×10^8 and 3×10^9 RADs. The other materials tested failed at total doses between 5×10^8 and 5×10^9 RADs. (auth)

45209 (ORNL–4145, pp 297–302) INDUSTRIAL APPLICATIONS OF NUCLEAR ENERGY. (Oak Ridge National Lab., Tenn.).

A survey was made of process applications in a desalination complex. Production of hydrogen by the electrolysis of water is being studied. (M.C.G.)

45210 (ORNL–4164, pp 24–34) ISOTOPE CHEMISTRY. (Oak Ridge National Lab., Tenn.).

Developments are reported for studies on: fractionation of lithium isotopes by extraction chromatography; solvent extraction of lithium and sodium ions by dibenzoylmethane–trioctylphosphine oxide systems; separation of lithium from other alkali metal ions by extraction chromatography; boron isotope separation; fractionation of carbon isotopes with molecular addition compounds of CO; a liquid-liquid system for enrichment of carbon isotopes; fractionation of carbon isotopes between CO and BH_3; relative reaction rates in the reduction of NO_3^-, NO_2^-, and NH_3OH to NH_3; isotope effects in the reduction of NO_3^- to NO_2^-; oxygen isotope enrichment; laser-equipped Raman spectrophotometer; Raman and infrared spectra of some Group IV-A and Group V-A hexafluoride ions; Raman spectra of ICl_3 and $CsBr_3$; and mass spectroscopy. (P.C.H.)

45211 (RFP–1037) REMOVAL OF SILICA FROM PLUTONIUM PROCESSING ANION EXCHANGE RESIN BY CAUSTIC WASH. DeGrazio, Robert P. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Oct. 11, 1967. Contract AT(29-1)-1106. 3p. Dep. CFSTI.

DOWEX-1 anion exchange resin is used for the recovery and purification of plutonium from nitrate solutions. Silica (SiO_2) is present in certain plutonium recovery streams and is adsorbed rapidly on anion resin columns. Consequently, the resin columns are plugged, preventing efficient processing of the plutonium. Experiments were conducted on a laboratory scale to determine the feasibility and effectiveness of removing silica from anion exchange resins with a sodium hydroxide wash. The results indicate that the procedure developed will effectively remove the silica and considerably increase the operational lifetime of the resin. Data show that approximately 99% of the adsorbed silica is removed. The concentration of plutonium in the caustic waste solution was below discard level, and therefore, did not require additional processing. (auth)

45212 (RISO–159) NEW METHODS FOR THE CARRIERFREE PRODUCTION OF VARIOUS ISOTOPES BY THE LIQUID LIQUID EXTRACTION TECHNIQUE. Mirza, M. Younas (Danish Atomic Energy Commission, Risoe. Research Establishment). Aug. 1967. 41p. Dep.

The extraction of Fe^{+3}, Cr^{+3}, Ni^{+2}, Co^{+2}, Mn^{+2}, Zn^{+2}, Sc^{+3}, Y^{+3}, La^{+3}, alkali metals, alkaline earth metals, rare earth elements, and fission products at various pH values into methyl isobutylketone containing 4-capryl-1-phenyl-3-methylpyrazolone-5 (PMCyP) was investigated. The quantitative extraction of Fe^{+3}, Y^{+3}, In^{+3}, Sc^{+3}, Sb^{+3}, rare earths, Ca^{+2}, Sr^{+2}, Cd^{+2}, Zn^{+2}, Co^{+2}, and Mn^{+2} was utilized for devising radiochemical procedures for the carrier-free separation of ^{54}Mn, ^{58}Co, ^{59}Fe, ^{45}Ca, ^{89}Sr, ^{115}Cd, and $^{89,90}Sr$ produced by $^{54}Fe(n,p)^{54}Mn$, $^{58}Ni(n,p)^{58}Co$, $^{59}Co(n,p)^{59}Fe$, $^{45}Sc(n,p)^{45}Ca$, $^{89}Y(n,p)^{89}Sr$, $^{235}U(n,f)^{115}Cd$, and $^{235}U(n,f)^{89,90}$ reactions and also for the separation of ^{140}La from $^{140}Ba-^{140}La$, ^{90}Y from $^{90}Sr-^{90}Y$, Sr from Sr–Ba, and ^{115m}In from $^{115}Cd-^{115m}In$ mixture, respectively. More than 90% added or calculated activities with a good decontamination factor were recovered. (auth) (DENMARK)

45213 (WASH–1076, pp 59–64) SAFEGUARDS PROCEDURES FOR A NUCLEAR FUEL REPROCESSING PLANT. Wischow, R. P.; Clark, J. R.; Roll, I. B.; Rodger, W. A. (Nuclear Fuel Services, Inc., West Valley, N. Y.).

Assumptions made for the safeguards system developed for the Nuclear Fuel Services fuel processing facility include: the safeguards system is capable of detecting diversion of nuclear materials but not necessarily capable of preventing it; an independent nuclear material balance may be established across the plant; and for part of the cycle the accountability system is supplemented by physical security. A staff of 18 resident inspectors is assumed and it is expected that such a program would cost roughly $500,000 annually for an anticipated effectiveness of 98%. (M.C.G.)

45214 (ORNL-tr-1768) KARLSRUHE REPROCESSING PLANT. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from a German report GWK-7. 15p. Dep. CFSTI. JCL $3.60 fs, $1.16 mf.

A reprocessing plant for irradiated nuclear fuels is under construction on the site of the Karlsruhe Nuclear Research Center. The plant is designed for a yearly throughput of 35 tons of uranium with an enrichment of up to 3% ^{235}U. Fuel elements with oxide fuels whose sheath material is insoluble in HNO_3 can be processed. The process is distinguished by the following characteristics: treatment of the elements takes place by breakdown into the individual pins, cutting the pins into short pieces, and dissolving the fuel from the slices with nitric acid. For separation of uranium from plutonium and fission products, a solvent extraction method using 30% tributyl phosphate in dodecane is provided (Purex process). The final products are nitrate solutions of plutonium and uranium. The basic construction, the plant, and the treatment process are described. (auth)

45215 SOLVENT EXTRACTION AND SEPARATION OF NIOBIUM AND TANTALUM BY MONOOCTYLESTER OF ANILINOBENZYLPHOSPHONIC ACID. Herak, M. M.; Jagodic, V.; Herak, M. J. (Inst. Ruder Boskovic, Zagreb). Croat. Chem. Acta, 39: 89-101(1967).

The extraction of Nb and Ta from aqueous solutions of their oxalato and fluoro complexes was studied, using the octylester of anilinobenzylphosphonic acid (MOABP) as extractant. The dependence of the extraction of Nb and Ta on the hydrochloric, sulfuric, nitric, perchloric, phosphoric, hydrofluoric, and oxalic acid concentration is described. A procedure for the separation of Nb from Ta was established. The back-extraction of the elements from the organic phase was carried out with hydrofluoric, phosphoric, and oxalic acid. The dependence of the extraction of Nb on the MOABP concentration in the organic phase, and oxalic or hydrofluoric acid in the aqueous phase was also studied. Distribution coefficients for Nb from oxalate solution were proportional to the second power of the MOABP concentration. The logarithmic dependence of the distribution coefficients for Nb from fluoride solution vs. the MOABP concentration gave a curve whose slope was 1.5. The extraction of Nb from oxalate solution was linearly proportional to the oxalic acid concentration, while the extraction of Nb from fluoride solution depended on the second power of the hydrofluoric acid concentration. Similar experiments with Ta were not made because of its very low extraction under the same conditions. The radionuclides ^{95}Nb and ^{182}Ta were used for the determination of the distribution coefficients of the elements in all of the experiments described. (auth)

45216 PRESENT STATUS AND PROBLEMS ON NON-AQUEOUS REPROCESSING. Nippon Genshiryoku Gakkaishi, 9: 530-42(Sept. 1967). (In Japanese).

A summary is given of the activities performed by the "Special Committee on Non-aqueous Reprocessing" in the two years from its establishment in April 1965 to its termination in March 1967. The review covers the present status of studies undertaken and the technical problems involved in the nonaqueous processing of irradiated nuclear fuels. The subjects reviewed include such processes as pyrometallurgical, pyrochemical, chloride/fluoride volatility, and aquafluor. The Committee also contributed to exchange of information through active discussions among the Committee members. (auth)

45217 FLOTATION OF MONAZITE USING ANIONIC CARBOXYLATE COLLECTORS. Farah, M. Y.; Fayed, Laila A. (Atomic Energy Establishment, Cairo). J. Chem. U.A.R., 8: 293-308(1965).

A new process is reported for concentration of monazite sand, as a source for nuclear fuel production. An all-flotation approach was investigated for upgrading black sands as well as 50% monazite middlings, as a result of a factorially designed plan to examine optimal consumption and periodic progress of conditioning, depression, collection, frothing, and aeration as a function of pulp density, pH values, and reagent action. Results revealed the optimal pulp-density to be 1:6 (solid-liquid ratio), the best surface conditioner to be water glass followed by soda and then by carbonate, and the optimal pH to be 10.0 for oleic acid and 10.5 for Cyanamid 710. Optimal oleic acid consumption, deduced from lab experiments, was 3 kg/t of ore. As a frother, pine oil served equally well as neutral detergents. Rougher concentrates containing 92% monazite, that were subsequently enriched to 97%, were obtainable. Recovery reached 99%. A pilot unit treating $\frac{1}{3}$ t/hr of ore is reported. (BBB)

45218 TWO-DIMENSIONAL PAPER CHROMATOGRAPHY OF FISSION PRODUCTS OF NATURAL URANIUM. Dimotakis, Paul N.; Perricos, Demetrius C. (Democritos Nuclear Research Center, Athens). Radiochim. Acta, 8: 15-17(Sept. 1967).

The technique of descending two-dimensional paper chromatography was applied to the separation of fission products of irradiated natural uranium. As solvents for the chromatography butanol–6N HCl (1:1) and ethanol–methanol–2N HCl (4:4:2) were used. The spots of the separated fission products were located by autoradiography and identification was made in most cases by observation of the gamma spectrum, by the half-lives, the maximum energies of beta rays, and the R_f values. (auth)

45219 EXTRACTION OF MONO-, DI-, AND TRIVALENT ELEMENTS IN VARIOUS SOLVENTS IN THE PRESENCE OF DI-2-ETHYLHEXYLPHOSPHORIC ACID. Dubuquoy, C.; Guillaumont, R.; Bouissieres, G. (CEN, Saclay, France. Institut de Physique Nucleaire, Arcueil, France). Radiochim. Acta, 8: 49-57(Sept. 1967). (In French).

The extraction of Na, Cs, Sr, Ba, and Eu(III) in presence of di-2-ethylhexylphosphoric acid (HDEHP) was studied as a function of various solvents. The distribution coefficient for each of the elements, D_M, was determined as a function of the total concentration of the complexing agent in the organic phase, $[HDEHP]_{org}$. The slopes of the linear part of the curves representing the function $D_M = f(\log [HDEHP]_{org})$ are equal to 2 for the alkali elements and to 2.5 for the alkaline earth metals, when using aliphatic solvents. The corresponding values for the same groups of elements are 2 and 3, respectively, when HDEHP is dissolved in aromatic solvents. Finally, the values of the slopes are 1.5 in case of Na and Cs, 2 and 4 in case of Ca and Sr, 3 and 6 in case of Eu(III), when polar solvents are used. Partition equilibria being compatible with the experimental results are suggested in order to explain the extraction of each of the elements under investigation. (auth)

45220 CHEMICAL PROBLEMS POSED BY THE OPERATION OF REACTORS. SYMPOSIUM ON THE CHEMISTRY OF REACTORS, JUELICH, OCTOBER 1966. Villard, R. (CEA, Paris). Radiochim. Acta, 8: 1-6(Sept. 1967). (In French).

Contamination and purification of water in reactors moderated with either D_2O or H_2O is discussed. The problem of the homogeneous poisoning of the water that can be used as a controlling device in H_2O- and D_2O-reactors is considered. Difficulties related to the isotopic dilution of heavy water and some precautions that have to be taken in order to avoid such pollution are described. Some methods used for recovering heavy water and converting it into a form suitable for further use are reported. (auth)

45221 STUDY OF THE EXTRACTIVE PROPERTIES OF PHOSPHINE OXIDES WITH THE AID OF MOLECULAR SPECTROSCOPY. Laskorin, B. N.; Fedorova, L. A.; Shatalov, V. V.; Stupin, N. P. Dokl. Akad. Nauk SSSR, 174: 1334-7(June 21, 1967). (In Russian).

The influence of the composition and structure of a series of phosphine oxides on their extractive properties was studied with the aid of ir spectra. The distribution coefficients and vibration frequencies of phosphine oxides and their complexes with uranium and the vibration frequencies of the P–O group of phosphine oxides were determined and tabulated. The spectra of trialkylphosphine oxides show a characteristic feature: when the sample becomes saturated with uranium, the number and frequency of vibrations of the uranyl ion change. Thus, at U contents of 0.01 and 0.025M, the two frequencies 930 and 950 cm^{-1} appear in the spectrum, whereas complete saturation is associated with the presence of only one frequency, 935 cm^{-1}. It was concluded that the mechanism of extraction with trialkylphosphine oxides from nitric acid solutions is analogous to that of extraction with TBP. (ATD)

45222 ION-EXCHANGE BEHAVIOR OF SEVERAL ELEMENTS IN MIXED SOLVENTS. Cummings, T.; Korkisch, J. (Univ., Vienna). Talanta, 14: 1185-9(Oct. 1967).

The distribution coefficients between the cation- and anion-exchangers Dowex 50 and Dowex 1, and aqueous solutions containing nitric or hydrochloric acid and organic solvents with or without amines or complexing agents, were obtained for a number of metals, including uranium, thorium, cerium, iron, copper, and nickel. The organic solvents were methanol, acetone, and dimethylformamide; the amines were tributylamine and tribenzylamine, and the complexing agents EDTA and citric acid. Both batch and column methods were used. (auth) (UK)

45223 EXTRACTION AND SEPARATION OF ZIRCONIUM AND HAFNIUM BY MEANS OF LIQUID ANION EXCHANGERS IN A HYDROCHLORIC ACID MEDIUM. III. EXTRACTION WITH TRI-CAPRYLYL-MONOMETHYL-AMMONIUM CHLORIDE. Bonfanti, F.; Cerrai, E.; Ghersini, G. (Laboratori CISE, Milan). Energ. Nucl. (Milan), 14: 578-85(Oct. 1967).

The extraction of zirconium and hafnium from hydrochloric acid solutions by means of tricaprylyl-monomethyl-ammonium chloride (Aliquat 336) in benzene was systematically studied. The effects of the various parameters involved in extraction are reported. 2.3×10^3 was obtained as zirconium–hafnium separation factor when extractions were carried out from concentrated hydrochloric acid added with small amounts of nitric acid. When separation was accomplished in a six-stage counter-current mixer-settler apparatus, very satisfactory results were obtained. (auth)

45224 ANALOGY BETWEEN AMINE EXTRACTION OF METALS AND THEIR ANION-EXCHANGE SORPTION ON SOLID RESINS. Allan, A.; Sanad, W. (Atomic Energy Establishment, Cairo). Microchem. J., 12: 418-26(Sept. 1967).

A systematic study of the extractability of ^{46}Sc, ^{51}Cr, ^{59}Fe, ^{60}Co, ^{65}Zn, ^{110}Ag, ^{115}Cd, ^{124}Sb, ^{141}Ce, ^{203}Hg, and ^{233}Pa from HNO_3, H_2SO_4, and HCl media was carried out. The extraction of these radionuclides from mixtures of HCl and HF was also investigated. An analogy between the extractability of these metals with an amine solution and their sorption on anion-exchange resins was noticed. (auth)

45225 DESIGN OF AIR PULSERS FOR PULSE COLUMN APPLICATION. Weech, M. E.; Knight, B. E. (Nuclear Fuel Services, Inc., West Valley, N. Y.). Ind. Eng. Chem., Process Design Develop., 6: 480-6(Oct. 1967).

Pulse columns, commonly used as liquid–liquid contactors in irradiated fuels reprocessing plants, require mechanisms for generating the pulse within the column. Pulse generation using timed pulses of compressed air have been used in at least two reprocessing plants. Design of these air pulsers requires the solution of three coupled nonlinear differential equations. The necessary differential equations for the system are given and methods for their solution, by numerical means, are presented. Solution requires the use of a digital computer. The computed results compared very favorably with measured results. Air pressure wave shapes, column pulse wave shapes, and characteristic operating curves are given for a typical pulse column–air pulser system. (auth)

45226 SEPARATION OF ^{99m}Tc FROM ^{99}Mo SORBED ON ALUMINIUM OXIDE BY PHYSIOLOGICAL SALINE SOLUTION. Ravnik, V.; Gorenc, B. (Univ. of Ljubljana, Yugoslavia). Atompraxis, 13: 258-9(June 1967).

Distribution of technetium-99m and molybdenum-99 between aluminum oxide and solutions of hydrochloric acid and between aluminum oxide and sodium chloride was investigated. Distribution coefficients were determined, as well as the elution curves for technetium-99m. The results prove that physiological saline solution can be used besides acids for preparation of technetium-99m solutions for medical purposes. (auth)

45227 CONCENTRATION AND SEPARATION OF IONS BY DONNAN MEMBRANE EQUILIBRIUM. Wallace, Richard M. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Contract AT(07-2)-1. Ind. Eng. Chem., Process Design Develop., 6: 423-31(Oct. 1967). (DP-MS-66-75).

Continuous countercurrent processes were developed on a laboratory scale using Donnan membrane equilibrium across permselective membranes to concentrate and separate ions in solution. This technique was used to concentrate uranyl ions from dilute solutions of uranyl nitrate, remove excess acid from a typical feed solution, concentrate trivalent ions such as lanthanum, remove strontium from sodium nitrate solutions, and separate silver and copper ions with a process based on differences in their ionic charge, and with processes based on differences in the stability of their complexes with different ligands. (auth)

45228 FLUIDIZED-BED DISPOSAL OF FLUORINE. Holmes, John T.; Koppel, Lowell B.; Jonke, Albert A. (Argonne National Lab., Ill.). Ind. Eng. Chem., Process Design Develop., 6: 408-13(Oct. 1967).

A fluidized bed process developed for the disposal of fluorine using activated alumina (AA) as the reactive solid, was found to be over 99.9% effective in the removal of fluorine from a gas stream and utilized the activated alumina to near the theoretical conversion. It has capability for high fluorine disposal rates and produces a free-flowing solid product for waste disposal. A factorial experiment was used to determine that increasing temperature (300 to 400°C), increasing ratio of bed depth to diameter (3 to 6), and decreasing particle size (399 to 183 microns) significantly increased the capacity (grams of F_2 per gram of AA) of activated alumina for fluorine removal. Changing the fluorine concentration from 5 to 75 volume % (vol %) or the velocity from 1.25 to 1.65 times the minimum fluidizing velocity (V_{mf}) had no significant effect. A higher velocity, 3.0 V_{mf}, appeared to decrease the capacity slightly. Other solid reactants that are less expensive than activated alumina were given preliminary evaluation. Soda ash appeared especially promising. (auth)

45229 PLANT FOR THE TREATMENT OF LIQUID RADIOACTIVE WASTES AT CISE. Cerrai, E.; Triulzi, C. (CISE, Milan). Acqua Ind., No. 45, 5-13(Sept.-Oct. 1966). (In Italian). (CISE-E-587).

The characteristics of the radioactive liquid wastes received for processing at the CISE plant are outlined. The treatment plant itself is described in detail and illustrated. The techniques used for the processing of the liquid wastes, the control methods, and the materials used are outlined. (J.S.R.)

45230 PROCESS FOR PRODUCING ^{131}I. (to Osterreichische Studiengesellschaft fuer Atomenergie GmbH). British Patent 1,085,640. Oct. 4, 1967. Priority date Dec. 6, 1963, Austria.

A method for producing ^{131}I in solution by irradiating telluric acid or orthotelluric acid and separating ^{131}I from its parent is proposed. The irradiated product is dissolved in an aqueous acidic medium with an added neutralizing agent. The residual tellurium compound is precipitated by means of a water-miscible organic reagent in which ^{131}I is soluble but telluric acid is not, then filtered. After separation, ^{131}I in solution is passed through a column of aluminum oxide. Paper chromatographic analyses showed the ^{131}I to be absolutely free of tellurium. (J.G.B.)

45231 IMPROVEMENTS IN IRRADIATED NUCLEAR FUEL RECOVERY. (to General Electric Co.). British Patent 1,084,642. Sept. 27, 1967. Priority date Feb. 10, 1965, United States.

A combination technique was developed for the chemical processing of irradiated fuels in which the number of required processing steps was reduced. An aqueous solution of the fuel is subjected to a single-cycle extraction using amines to produce an organic stream containing substantially all of the plutonium and an aqueous raffinate containing substantially all of the uranium and fission products. The plutonium is stripped from the organic stream. The aqueous raffinate stream is dehydrated and the solids fluorinated. The uranium fluoride is then separated from fission-product fluorides by volatilization. (M.C.G.)

45232 PROCESS FOR REPROCESSING USED URANIUM FUEL. (to Japan Atomic Energy Research Inst.). British Patent 1,086,966. Oct. 11, 1967. Priority date Sept. 9, 1964, Japan.

A method for reprocessing used nuclear fuel is described. The fuel is dissolved in a molten-salt bath, heated higher than 210°C, consisting of ammonium nitrate and one or more alkali metal nitrates. The molten salt is filtered through glass or quartz fiber filter, glass powder, γ-alumina or calcium oxalate packed in a column, then the filtrate is heated to at least 330°C in order to expel gaseous fission products, thereby obtaining uranium as a uranium compound precipitate. (D.H.M.)

EARTH SCIENCES

Geology

Refer also to abstracts 45039 and 45310.

45233 (NP-16900, pp 28-34) CANADIAN FALLOUT DATA FOR MARCH 1967. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.).

Data from Canadian fallout monitoring programs for air, precipitation, and milk during March of 1967 are tabulated. (L.C.L.)

45234 (ORO-3585-1) STUDIES ON IRON METEORITES. Annual Progress Report, January 1-December 31, 1966. Fisher, David E. (Miami Univ., Fla. Inst. of Marine Science). Feb. 3, 1967. Contract AT(40-1)-3585. 58p. Dep. CFSTI.

Research is reported on: cosmogenic tritium problems in iron meteorites, space erosion effects in iron meteorites, aluminum abundance in chondrites and chondrules, isotopic abundances of xenon in meteorites, elemental abundances in microtektites, abundance of chlorine in iron meteorites, and potassium/argon ages in iron meteorites. (M.C.G.)

45235 (UCID-15132(Add.)) ACCEPTABILITY OF THE GASBUGGY SITE. Addendum. Rawson, Donald E.; Korver, John A. (California Univ., Livermore. Lawrence Radiation Lab.). Aug. 14, 1967. 7p. DTIE.

Two invalid assumptions were made in the model used for the original analysis of the Gasbuggy site. The first was that water is incompressible, and the second that water at the site is unconfined. New calculations were made with a model which takes into account both the confinement and compressibility of the water at this site. The results of the new calculations indicate little likelihood of flooding of the Gasbuggy chimney. (L.C.L.)

45236 ATOMIC ENERGY AND THE IHD. Haney, W. A. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Geophys. Union, 48: 877-9(Sept, 1967).

The areas in which atomic energy and hydrology have supported and benefitted each other are discussed. Included are the following: in-well measurements with radioisotopes to determine local direction and water flow rate in the saturated zone; water flow through soils; behavior of radionuclides in the Columbia River, which also yields information on bottom distribution and movement of sediments, water scouring, and retransport; and water quality models made from comprehensive studies of the temperature regime of the Columbia River. (F.S.)

45237 OCEANIC BASALT LEADS: A NEW INTERPRETATION AND AN INDEPENDENT AGE FOR THE EARTH. Ulrych, T. J. (Univ. of British Columbia, Vancouver). Science, 158: 252-6(Oct. 13, 1967).

A modified form of a model proposed by Gerling and Shukolyukov is used to study the development of lead isotopic ratios in oceanic basalts. This modified model yields an age for the earth which is calculated to be 4530 ± 40 million years. The significance of this calculation is that it is independent of the knowledge of the ages of the samples studied. It is also found that although the source of the basalts is not generally homogeneous, the differentiation of this source from a closed system has occurred fairly recently geologically. The oldest time for the differentiation, 1230± 350 million years ago, has been found for Mid-Atlantic tholeiites. (auth)

45238 STABILIZATION AND DETERMINATION OF TRACES OF SILVER IN WATERS. West, Foymae K.; West, Philip W.; Ramakrishna, T. V. (Louisiana State Univ., Baton Rouge). Environ. Sci. Technol., 1: 717-20(Sept, 1967).

A method is described for the determination of silver in water in the parts-per-million to parts-per-billion range. EDTA is employed to stabilize the sample to prevent adsorptive losses of the silver to container walls. Quantitative measurements are made by atomic absorption spectrometry on silver dithizonate complexes after they have been isolated and concentrated into ethyl propionate. The method is specific, convenient, accurate, and widely applicable. (auth)

45239 REGIONAL VARIATIONS OF GAMMA RADIATION OVER HYDROCARBON DEPOSITS. Dalluegge, Peter. Z. Angew. Geol., 12: 297-305(June 1966). (In German).

Theoretical and field studies on variations of γ radiation levels in relation to petroleum deposits are reported. Thorium, U, and Ra may be associated with oil strata. The radiometric anomalies above petroleum deposits are mainly caused by hydrocarbons migrating into clayey rocks. Isoradiation contour charts of some oil fields are illustrated. The use of surveys of γ radiation levels in wells and radioactivity core logs to detect hydrocarbon deposits is demonstrated. (BBB)

45240 ABSORPTION OF NATURAL FALLOUT IN SOIL. Israel, Hans; Haas, Roland (Meteorologisches Observatorium, Aachen). Z. Geophys., 28: 289-92(1962).

The atmospheric content of natural radioactive material is considered as the consequence of a circulation process. After the exhalation of radon and thoron from the soil they will be distributed in the atmosphere, and returned to the ground by precipitation and other processes, most of them after having changed into their decay products. Here they are washed into the soil by rain. In determining their distribution in the soil, it was assumed that the laws governing this distribution may be applied also to the distribution of artificial radioactive fallout. This expectation was verified experimentally. In the described experiments on different kinds of soil, as a tracer ThB (^{212}Pb) was used because it can be easily separated from its mother products, thoron and ThA; also, only one daughter product must be considered, namely ThC (^{212}Bi). The measurements were made with artificial rain, i.e., by sprinkling water, treated with thoron, on different types of soil. It is shown that radioactivity is absorbed in the uppermost layers of the ground. The distribution of ThB in the soil was found to be very similar to that of ^{90}Sr in fallout. These results justified the use of ThB as a tracer to detect the fallout distribution in soil. (BBB)

45241 STUDY OF AN URANINITE COLLECTED FROM A PEGMATITE IN RAJASTHAN (INDIA). Choudari, Rambabu; Kosztolanyi, Ch.; Coppens, R. (Centre de Recherches Radiogeologiques, Nancy). Bull. Soc. Franc. Mineral. Crist., 90: 77-81(Jan.-Mar. 1967). (In French).

Geologic data are presented, and results of various other studies are reported on a pegmatitic uraninite from the Bhunas mica mine in Rajasthan (Rajputana, India). The results include data on physical characteristics, chemical analyses, x-ray diffraction powder patterns, and determination of age by lead method. The studies revealed that this crystal uraninite (unit cell dimension = 5472 ± 0.002 Å) is an ideally suited mineral for isotopic determination of age. The absolute age of the mineral was found to be 906 ± 20 M yr, on the basis of ^{207}Pb/^{235}U measurements. This is considered as more representative of that of uraninite than of the pegmatite, with which it is syngenetic. Another uraninite in pegmatite found in Singar (Gaya district) had an age of 955 ± 40 M yr. (BBB)

45242 THE IMPORTANCE OF BETA-RADIOACTIVITY MEASUREMENTS IN REPRESENTATIVE AND RESEARCH BASINS. Balek, Jaroslav (Inst. of Hydrodynamics, Prague). pp 347-50 of Union Intern. Geodesique et de Geophysique., Assoc. Intern. Hydrol. Sci., Symposium. Budapest, Sept. 29 to Oct. 1, 1965. Ghent, Assoc. Intern. Hydrol. Sci., 1965.

At the Volynka River research basin in Czechoslovakia, β radioactivity of rain and river water have been carried out since 1963 in addition to other hydrological measurements. The measurements of radioactivity of water from rainfall and of river water passing through the channel in the form of waves caused by rainstorms showed considerable differences in radioactivity. Different values for radioactivity were also recorded during the different phases of flooding. The assumption was made that all the radioactivity of infiltrating water was absorbed by pedologic and geologic layers, while the radioactivity of surface runoff was not diminished appreciably. If this assumption is valid, it should be possible on the basis of the measured radioactivity to elucidate surface runoff accurately. Measurements showed that almost every rainfall causing a flood wave contained measurable radioactivity, due especially to fallout from nuclear test explosions. Radionuclide absorption was studied on 30 soil samples from the Volynka basin. A solution of fission products was shaken and placed on the soil samples under static conditions, or the same solution was passed through a column of soil. The distribution coefficients were high for most radionuclides, except for anionic ones. These lab tests results were compared with those obtained in the field. It was shown that on the basis of the findings that estimates of surface runoff can be made. Even though it was not possible at this time to determine also the limits between interflow and groundwater flow on the basis of the described method, its use is expected to make possible substantiation of findings on the runoff process during the passage of flood waves. The method has been applied to 9 instances of flood waves, always with positive results. (BBB)

45243 CYCLOTHEMATIC SEDIMENTATION AND GEOCHEMICAL DISTRIBUTION OF URANIUM AND COPPER IN THE MARINE MIOCENE SERIES OF THE TAGE BASIN, PORTUGAL. Jurain, G.; Haguenauer, B. (Univ., Nancy). Geol. Rundsch., 55: 454-9(1966). (In French).

The neogene basin of the Tage River shows a differentiation in 5 sedimentary periods of different facies. The geochemical features permitted U and Cu to be used to trace the sedimentary pattern. The sedimentary unit studied corresponded to a cyclotheme. The results showed the opposite behavior of U and Cu in the cyclotheme. The grade of U increased while that of Cu decreased. According to the scale of a sedimentary cycle the grade of Cu decreased toward the top; at the base the grades were higher. Uranium showed contrasting changes. The ratio Cu/U was apparently related to the particular environment. In the sedimentary series U and Cu differed in their distribution. Uranium was enriched preferentially in the very fine grained sediments, whereas Cu was found in the coarse deposits which contained continental alluvial deposits and which appeared discordantly on the underlaying beds. Thus Cu showed a clear connection with diastrophic processes. (BBB)

45244 TERRESTRIAL BACKGROUND RADIATION IN JAPAN. Yamagata, N.; Iwashima, K. (Inst. of Public Health, Tokyo). Health Phys., 13: 1145-8(Oct. 1967).

In July/August 1965 a soil survey was conducted throughout Japan in order to estimate background terrestrial radiation in different parts of the country. The present communication deals only with the radiation due to uranium and thorium nuclides, together with ^{40}K. Experimental techniques are described and results are summarized. Mean values obtained were: 1.3 ± 0.6 ppM for uranium, 5.7 ± 1.7 ppM for thorium, and 1.49 ± 0.58 ppM for potassium. Larger local variations for uranium and potassium, compared with thorium, may reflect the greater tendency of these elements to leach during soil formation and weathering processes. Estimates of gamma exposure rates due to terrestrial radionuclides at one meter above ground are tabulated. A little less than half of the total terrestrial radiation was contributed by ^{40}K, and 20% was attributable to the uranium series. The exposure rate due to locality varied by a factor of a little less than three. The population weighted mean was 5.4 μR/hr (47 mR/yr), the range being 25 to 69 mR/yr. (UK)

45245 ^{87}Rb-^{87}Sr AGES OF SILICATE INCLUSIONS IN IRON METEORITES. Burnett, D. S.; Wasserburg, G. J. (California Inst. of Tech., Pasadena). Contract AT(04-3)-427. Earth Planet. Sci. Lett., 2: 397-408(Aug. 1967).

Rb–Sr measurements were made on silicate inclusions extracted from the iron meteorites Toluca, Odessa, Four Corners, Linwood, Pine River, Colomera and Weekeroo Station. Strontium isotopic anaylses were made on samples as small as 24 ng. The typical Sr and Rb blanks were 2×10^{-9} g and 2×10^{-9} g and 2×10^{-10} g, respectively. In certain cases it was possible to obtain relatively precise isochrons. With the exception of Colomera, all of these samples gave ages compatible with 4.4 to 4.8×10^9 yr. The Colomera data scatter widely and do not meet the requirements for defining a reliable age. None of the samples are compatible with an age of 6×10^9 yr. The primary strontium observed or estimated for Toluca and Pine River agrees with that obtained from achondrites. It is evident that extensive Rb–Sr isotopic studies may be made on a large number of rather typical iron meteorites. (auth)

Meteorology

Refer also to abstract 45240.

45246 (MLM-1425) ENVIRONMENTAL MONITORING REPORT: JANUARY-JUNE 1967. Anderson, H. F.; Sheehan, W. E. (Mound Lab., Miamisburg, Ohio). July 17, 1967. Contract AT(33-1)-Gen-53. 37p. Dep. CFSTI.

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, is presented for the first half of 1967. The average concentration of radionuclides from Mound Laboratory in the Great Miami River and in the environmental air (average of all zones) was within the standards specified by the Atomic Energy Commission. (auth)

45247 (NP-16766) EINSATZ VON HELIKOPTERN ZUR MESSUNG DER GELAENDEVERSTRAHLUNG. (Use of Helicopters for Measurement of Ground Radiation). ABC Bulletin No. 8. Gut, J. (European Organization for Nuclear Research, Geneva (Switzerland)). Sept. 1966. 20p. (In German). Dep.

The use of helicopters for measuring ground radiation following a nuclear explosion is examined. Theoretical consideration is given to the flight height of the helicopter, the effect of the ground surface, and the time required for a helicopter at a given speed to measure radiation over a fixed amount of ground surface. The technical problems associated with the detection equipment and the helicopter are described. A practical method of ground radiation measurement is outlined which uses a helicopter with both a pilot and an operator for the detection equipment. It is concluded that ground radiation measurement by means of helicopters can be fast, precise, and without great expense. (L.C.L.)

45248 (NYO-3685-12) ON THE PROBLEM OF THE "EFFECTIVE CHIMNEY HEIGHT." Csanady, G. T. (Waterloo Univ. (Ontario)). Sept. 1967. Contract AT(30-1)-3685. 25p. (CONF-670931-14). Dep. CFSTI.

From USAEC Meteorological Information Meeting, Chalk River, Ontario, Canada.

Chimney plume studies were made at the University of Waterloo, Waterloo, Ontario, to determine the effect of chimney height on the dipsersion of particles from smoke plumes. Theoretical concentration distribution curves and plume height values are presented as a function of atmospheric wind speeds. These are compared with measured values. An effective chimney height for a given amount of ground accumulation of smoke particles is derived. (L.C.L.)

45249 (ORNL-4146, pp 2-35) ENVIRONS MONITORING. (Oak Ridge National Lab., Tenn.).

Data and information are presented concerning atmospheric monitoring in the East Tennessee area, rainwater analyses, Clinch River water analyses, milk analyses, and background radiation measurements. Details of the annual survey of the Clinch and Tennessee Rivers are included. (J.R.D.)

45250 DETERMINATION OF RADIOSTRONTIUM IN FOOD AND OTHER ENVIRONMENTAL SAMPLES. Porter, C. R.; Kahn, B.; Carter, M. W.; Rehnberg, G. L.; Pepper, E. W. (Dept. of Health, Education, and Welfare, Rockville, Md.). Environ. Sci. Technol., 1: 745-50(Sept. 1967).

Radiostrontium in environmental samples is separated from the other alkaline earths in an EDTA medium. Earlier methods using the ion-exchange technique were modified to permit analysis of large samples, to provide quantitative separation from calcium in the wide range of concentrations normally encountered, to recover strontium in high yield, and to accommodate multiple analyses. The sensitivity of the procedure is 0.1 pC per gram of ash when samples are counted for 50 minutes in a low-background beta counter; the average strontium yield is 70%. Decontamination factors are 5×10^4 from calcium and at least 1×10^4 from major radionuclides in fallout other than barium. Barium decontamination is 130. A procedure for the analysis of the barium plus radium fraction is also given. (auth)

45251 ATMOSPHERIC TRANSPORT AND DIFFUSION AT COASTAL SITES. Van der Hoven, Isaac (Environmental Science Services Administration, Idaho Falls, Idaho). Nucl. Safety, 8: 490-9(Sept.-Oct. 1967).

Overland atmospheric diffusion is three times more rapid than overwater diffusion, on the average, when the water is colder than air temperatures over land. The transport distance required to complete the transition from overwater to overland diffusion is a function of plume height, wind speed, and vertical temperature profile. Diffusion models have been developed to account for the diffusion rates within this transition zone. Daily reversals between land and sea breezes result in local variations of coastline atmospheric trajectories; large-scale pressure-gradient effects result in straight-line trajectories. 36 references. (auth)

45252 CLIMATOLOGICAL ASPECTS OF NATURAL RADIOACTIVITY. Israel, H.; Stiller, S. (Technische Hochschule, Aachen). Z. Geophys., 29: 51-6(1963).

Use of filters for absorption of the aerosols in the atmosphere to obtain a mixture of natural and artificial activity composed of the following 3 components is discussed: daughter-products of Rn, daughter-products of Th, and fallout fission products. In general, the amount of the Rn daughter products is many times greater than 2 other components while these components contribute about the same amount to the total activity. For this reason the first component can be measured by recording the activity on the filter during the collection process. The other 2 components, can be determined by analyzing the decay curves. During the period of nuclear weapon test cessation from 1959 to 1961, there was an opportunity to obtain records for the Th daughter products also, using the monitors employed by the Deutscher Wetterdienst. During this period the fission product level in the air became so low that the activity of the collectors 2 days after the collection almost corresponded to that of ThB. Diurnal levels of RaB and ThB were estimated from the records of the stations at Aix-la-Chapelle,

Berlin, and Munich for the period from January, 1960 to August, 1961. The mean values were then examined in relation to meteorological influences. Comparison of the results from the 3 locations showed a clear climatological effect on natural radioactivity of the atmosphere. The dependence on wind directions and air masses found at Berlin and Aix-la-Chapelle could be explained by the so-called coast effect. At Munich the mean values of radioactivity were higher than at the 2 other stations, possibly caused by the higher exhalation of Rn and Th from the basic rock structure (granite) of the Alps. (BBB)

45253 SCAVENGING OF ATMOSPHERIC PARTICLES BY ICE CRYSTALS. Vittori, Ottavio A. (Osservatorio Mt. Cimone, Italy); Prodi, Vittorio. J. Atmos. Sci., 24: 533-8 (Sept. 1967).

Ice crystals growing in supercooled clouds studied in a Nakaya chamber to determine their ability to include foreign particles in their structure. In a series of experiments on wash-outs ratios of condensing water and growing ice, ice crystals proved to be 16 times more efficient than water in capturing atmospheric particles. The existence of Facy's "dust-free space" around evaporating surfaces was confirmed. The dust-free space around supercooled droplets is considered, in connection with Stefan flow, to be an important mechanism in bringing particles toward ice surfaces, and may account for the observed wash-out efficiency of ice crystals. (auth)

45254 COMPUTER MODEL FOR THE PREDICTION OF THE DISPERSION OF AIRBORNE RADIOACTIVE POLLUTANTS. Plato, Phillip A.; Menker, Donald F.; Dauer, Maxwell (Univ. of Miami, Florida). Health Phys., 13: 1105-15(Oct. 1967).

Two computer programs are presented, written for an IBM 1401/7040 digital computer in a FORTRAN IV computer language. The programs are called RADS and ARADS, acronyms for Radiological Atmospheric Dispersion Study and Alternate RADS, respectively. Both programs are designed to investigate the use of various equations formulated to predict the dispersion of radioactive effluents deposited into the atmosphere from a smokestack. The release of the effluents may be of either an instantaneous or continuous nature. Predictions of atmospheric concentrations are made for approximately 600 points throughout an observation area surrounding the source of release, allowing contour lines of equal concentrations to be drawn. The RADS program was designed for one particular effluent release. The program predicts the path of the smoke from the source to one of the boundaries of the observation area. Predictions are then made concerning the dispersion of the smoke. The ARADS program uses average meteorological conditions to predict the air concentrations resulting from long-term releases of a smokestack effluent. The output data for both programs contain a scaled map of the observation area showing the location of the predicted concentrations, in order to simplify the drawing of the contour lines. While the authenticity of the prediction equations is not certain, a definite relationship between relative air concentrations with respect to the location of the source was established. The programs permit fast, accurate, and voluminous solutions to the complex equations, and provide a tool with which to examine the prediction equations themselves. (auth) (UK)

45255 EFFECT OF NUCLEAR EXPLOSIONS ON THE ATMOSPHERIC POTENTIAL GRADIENT NEAR THE GROUND. Agarwala, K. S. (Meteorological Office, New Delhi). Indian J. Meteorol. Geophys., 15: 437-8(1964).

The possible variation of the atmospheric potential gradient due to nuclear explosions was examined with reference to the available data for atmospheric potential gradient near the ground for 2 Indian stations, Colaba (Bombay) and Poona. An increase in ionization near the ground caused by fission products from nuclear explosions should increase the conductivity of the air and lower the potential gradient in the lower atmosphere. Some data on the ground deposition of fission products from nuclear test explosions at the Bombay sampling stations for the period 1956 to 1959 are given along with the yearly potential gradient values of selected so-called quiet days based on records obtained at the Colaba Observatory, Bombay. It was seen that while the fallout deposition data at Bombay showed an increase in radioactivity following nuclear tests, the atmospheric potential gradient values near the ground for the corresponding years did not indicate any variation due to nuclear explosions. The yearly potential gradient values recorded at Colaba and Poona Observatories are given. The potential gradient values at Colaba (Bombay) showed an increase and not decrease, and the Poona values also did not decrease. Lack of variation in atmospheric potential gradient on account of nuclear explosions as recorded by the Indian stations is in disagreement with findings of certain stations in Europe. (BBB)

45256 METEOROLOGIC STUDY OF TRANSPORT OF RADIOACTIVE FALLOUT IN THE ATMOSPHERE RESULTING FROM THE SOVIET TESTS IN SEPTEMBER 1961. Tanaevsky, C. (Faculty of Sciences, Paris); Blanchet, J. J. Mec. Phys. Atmos., 6: 13-21(Jan.-Mar. 1964). (In French).

A study was made of the total β activity in the air recorded at the following sampling stations: Chilton (U.K.), Miami, Washington, Moosonee (U.S.), Paris, Tamanrasset (Algeria), and Athens. An attempt was made to trace the trajectory of the radioactive debris from the first 3 Soviet nuclear tests in 1961 by comparing the reports from the various localities. However, certain types of air movement prevented this, and instead lines of probability were established as an indication of where there was the most probability of locating the radioactive cloud. Tables are presented showing that the actual location of the various fronts of the radioactive air mass corresponded almost exactly to the probability lines derived. The path traced by the peak atmospheric radioactivity was circumpolar, and the highest speed of its movement corresponded to that of the polar jet stream. Interpretation of the results in terms of air mass dynamics is discussed. (BBB)

45257 AN EXPERIMENTAL INVESTIGATION TO ESTABLISH MINIMUM DETECTABLE LEVELS OF ATOMIC LITHIUM IN THE ATMOSPHERE. Gardner, Jack Allen. Raleigh, N. C. North Carolina State Univ., 1967. 119p.

Thesis.

An experimental investigation was undertaken to establish limits on the lithium number density in the upper atmosphere. It is believed that the lithium emission measurements taken during the period between the years 1958 and 1963 were strongly influenced by high-altitude thermonuclear explosions detonated during that period. This investigation was performed during a four-month period between July and October, 1966. It was concluded that the emission rate for lithium in the upper atmosphere is less than 1 Rayleigh due to lithium atoms above 65 km. This value constitutes an instrumental limit since the experimental results never exhibited characteristics necessary for establishing the presence of a lithium stratum in the upper atmosphere. To obtain a comprehensive understanding of this experimental endeavor, a rather complete description of technique, instrumentation, and theory is included in this compendium. The birefringent photometer used in this work is discussed in detail. The concept of a screening height for approximation of the solar transmission function was theoretically evaluated for the case of lithium and found to be highly suspect as a meaningful approximation. (auth)

Mineralogy

Refer also to abstracts 45235, 45247, 45257, and 45492.

45258 HYDROGEOCHEMICAL CONDITIONS OF FORMATION OF URANYL ARSENATES AND PHOSPHATES (URAN-MICAS, URANITES). Serebrennikov, V. S. Geochem. Int. (Engl. Transl.), 3: 391(1966).

The formation of uranites occurs when the active concentration product of the ions constituting these minerals reach the value of their solubility product in the subterranean water of a supergene zone. For sodium and calcium arsenates and uranyl phosphates the pH values for natural water most favorable to the formation of these substances is 6.8 to 7.1. On the basis of detailed sampling of subterranean water in the aeration zone in ore-bearing sectors rich in autunite, the value of the activity product for autunite was determined as $5.5 \pm 4.5 \times 10^{-46}$. In the U deposits studied it was found that hydrogeochemical conditions for the formation of arsenic and phosphate uranites corresponded to the presence of these minerals in the oxidation zones of the U deposits. This suggests that secondary U mineralization in oxidation zones of the deposits is fairly rapidly transformed as hydrogeochemical conditions in the deposit change in the course of geologic history. (BBB)

45259 PREFACE OF THE SWISS GEOTECHNICAL COMMISSION AND OF THE WORKING COMMITTEE FOR RESEARCH ON SWISS MINERALS AND ROCKS FOR ATOMIC FUELS AND RARE ELEMENTS. de Quervain, F. (Univ., Bern). pp 1-4 of Studies on Radioactive Minerals and Rocks in Switzerland. Survey Map of Uranium and Thorium Mineralization of the Western Alps. Bern, Kuemmerly and Frey, 1962. (In German and French).

Since the middle of the 1950's, knowledge of U- and Th-containing minerals in the Alps has expanded from a knowledge of only isolated deposits to the discovery of a large number of U deposits of different types. Studies were carried out by the respective French and Italian organizations complementary to the Swiss as well; in Switzerland, studies were made by E. Niggli, K.

Baechtiger, Th. Huegi, and E. Rickenbach, the latter 2 in connection with the Arbeitsausschuss between 1957 and 1961. A map indicates by numerals regions with notable enrichment in U and Th, although different mineralizations are not indicated. They follow the geologic-petrographic character of the host mineralization in general. When the map was published, further investigations were still in progress; modifications of the map will be included on a later edition. (BBB)

45260 EXPLICATIVE NOTES ON THE URANIUM MINERALIZATIONS IN SWISS TERRITORY. Huegi, Th.; de Quervain, F.; Rickenbach, E. (Univ., Bern). pp 5-14 of Studies on Radioactive Minerals and Rocks in Switzerland. Survey Map of Uranium and Thorium Mineralization of the Western Alps. Bern, Kuemmerly and Frey, 1962. (In German and French).

Descriptive notes for various U deposits are given. In particular, U mineralizations in the gneiss of the central massif at Naters and Tiraun and in the granite of Bregaglia are noted. Deposits of U in the gneiss, micaschists and phyllites of Valais (Iserables, Le Fou, Grand Alou, Col des Mines, Valsorey, Chalevay, La Tsacha, Cleuson, Prolin, Mont Noble, Sex de Marinda, Motec, and Taesch) and Grisons (Val Madris), mineralizations in permo-triasic quartzites of the pennic region (Sarreyer, Bec de Midi, Illgraben, Zeneggen, Toerbel, Ackersand II in the Zermatt), deposits in the sandstone of Perm (Muertschenalp, Affeier), deposits in mesozoic marbles of the Pennicum (Innerferrera), elevated levels in bituminous schists of the Trias (Meride) and in the lignites of the tertiary molasse (Bleiken, Blapbach, Echeltswil, Kaepfnach, Riedhof, and Sellenbueren). Sixteen references since 1955 and five earlier references are listed. (BBB)

45261 URANIFEROUS INDICES OF THE FRENCH ALPS. Lenoble, A. (CEA, Fontenay-aux-Roses, France). pp 15-18 of Studies on Radioactive Minerals and Rocks in Switzerland. Survey Map of Uranium and Thorium Mineralization of the Western Alps. Bern, Kuemmerly and Frey, 1962. (In French).

The least important deposits are in the Northern Alps (Beaufort, Vaujany, Champagny). Mineralizations of the Esterel are in relation with Permian rhyolites or in interstratified sandy schists (Ravin du Gratadis, La Plantade, Le Charbonnier, Castelly, Pont de la Cabre). In the Maritime Alps, most deposits are in the Permian, except for Liouc, which is in the Trias, and uraniferous mineralization is associated with Cu and carbonaceous debris (St. Sauveur, Roya, Millefonds, Granges du Colonel, Est de la Cime de Raus, Macruera Oriental, Scandail, Vallee de la Gordolasque, Vallauria mine); the highest counting rates are found at La Plantade (autunite and renardite mineralizations), Le Charbonnier (renardite, phosphuranylite, autunite, uranocircite), and Cime de Raus (pitchblende, spherolite), where activity ranges between 4000 and 5000 counts per sec. (BBB)

45262 SHORT ILLUSTRATION OF ITALIAN MINERALIZATIONS. Marinelli, G.; Mittempergher, M. (Univ., Pisa. Comitato Nazionale per le Ricerche Nucleari, Rome). pp 19-27 of Studies on Radioactive Minerals and Rocks in Switzerland. Survey Map of Uranium and Thorium Mineralization of the Western Alps. Bera, Kuemmerly and Frey, 1962. (In Italian).

Mineralizations known to be Carboniferous and Permo-Trias metamorphic in the Pennicus zone include Pietra Ligure, Bric Colme, Lurisia, Fiolera, Ciarma, Rio Freddo, Chiotti, Val Marmora, Preit, Monte Bracco, Ulzio, Monte Seguret, Salbertrande, Moncenisio-Strada, Borgone-Susa, Val Grisanche, Val Formazza, Gran Pilastro, Picco dei Tre Signori, and Malles Venosta. Uraniferous concentrations in Permian sandstone of the Southern Alps are at Pizzo Termello, Condino, Val Daone, Val Rendena, Val Marano, and Val Bondione. Mineralizations in late Paleozoic vulcanites are found in ignimbrites of Trentino-Alto Adige and at Valganna and Novazza. Some deposits are found in the granite of Mont Blanc. Mineralizations of Th are noted at Mont Mort and in the thoriferous uraninite of Traversella; other Th deposits are at the Aprilliano zone in Sila (Calabria) and Nettuno (Rome). A bibliography with 44 references is appended. (BBB)

45263 CONTRIBUTION TO THE KNOWLEDGE OF THE URANIFEROUS MINERALS OF CALABRIA. THE METAUTUNITE OF S. GIOVANNI IN FIORE. Burragato, F. Period. Mineral., 35: 387-401(1966). (In Italian).

The optical and structural characteristics of a metautunite from S. Giovanni in Fiore, Calabria, are given. The characteristics α (1.584) and β (1.597), variable optical axis angle (5°–35°), and negative optical sign confirm the designation as a metautunite I. Spectrochemical analysis and x-ray fluorescence analysis indicate the principal constituents as U, Ca, and P, with lesser amounts of Fe, Si, and Al, and traces of As and Mg. The lattice constants were found to be $a_0 = 6.993$ Å, $c_0 = 8.462$ Å, $c/a = 1.210$; d_{hkl} are tabulated. The differential thermal analysis curve and d_{hkl} for dehydrated samples are given, and the differences between hydrated and dehydrated samples from standard sources and the new one are discussed. (BBB)

45264 USE OF THE NEUTRON–GAMMA METHOD FOR DISTINGUISHING GAS STRATA IN CASED WELLS OF THE YEYSKO–BEREZAN GAS REGION. Us, E. M. (Il'sk Geophysical Logging Office, USSR). Petrol. Geol. (USSR) (Engl. Transl.), 6: 637-40(Jan. 1967).

Recognition of reservoirs according to gas and water saturation in cased wells by radiometric methods is used in determining the position of the water-oil contact for detecting uneven constructions of the boundaries of pools and preventing the possible breakout of the pool into isolated sectors. The use of a neutron γ-ray method as a practical means for recognizing reservoirs according to gas and water saturation in cased wells was explored. During a study of the productive horizon by sonde 50 cm in length, it was found that for gas-bearing part of a stratum of uniform sandstone of the Lower Cretaceous productive level the intensity of induced γ radiation was considerably higher than for the water-bearing part. The intensity of induced γ radiation opposite gas-bearing strata is determined by the H content, which in turn is governed by the lithology of the stratum, its porosity, and coefficient of gas saturation. For sandy-clayey reservoirs the variation in clay content of the stratum controlled the intensity of induced γ radiation. The relative values of induced γ radiation opposite gas-bearing strata for the fields considered ranged from 1.09 to 1.33, and opposite water-bearing strata 1.03 to 1.21. Thus, for recognition of water-bearing and gas-bearing strata, the use of only one value of induced radiation without taking into account the lithology is inadequate. Therefore, in interpretation, use was also made of electrical logs, which indicated the lithology of the strata. (BBB)

45265 ASPHALTIC TRACES IN BITUMINOUS SHALES IN THE LOWER WESTPHALIAN B OF THE COAL MEASURES OF THE RUHR BASIN. Rabitz, Albrecht; Wolf, Monika (Geologisches Landesamt Nordrhein-Westfalen, Krefeld, Ger.). Erdoel Kohle-Erdgas-Petrochem., 20: 257-61(Apr. 1967). (In German).

The presence and presumed origin of U and Th are reported in shales of the marine band of the top of the Katharina coal seam (Westphalian B), where in 2 different places organic material was discovered. By chemical-petrographical investigations the organic substance was determined to be asphalt. Gas-chromatographic analysis of a bituminous extract of the shale revealed a high amount of n-paraffins with chain length from 11 to 30 C atoms. Predominance of n-paraffins with odd C-atom numbers was not observed. These results indicate that the initial substances were probably animal residues of the marine shale. Numerous radioactive halos found on the polished surface of asphaltic granules were due to U. However, only Th was ascertained in the ambient shale. The reasons for the enrichment of the U in the vicinity of the organic substance are discussed. It is suggested that U enrichment in asphalt of marine sediments may have resulted from adsorption of uranyl ion on the organic material followed by formation of insoluble U compounds in reducing media. (BBB)

45266 URANIUM SEARCH PROGRAMME. S. Afr. Mining Eng. J., 78: 1465(June 23, 1967).

It is expected that in the foreseeable future that the demand for U will exceed the supply as determined by present known reserves in the view of the Atomic Energy Board of South Africa, and a program has been prepared for renewed exploration in the Republic. It incorporates a detailed investigation and evaluation of the extent and U content of all radioactive beds — whether or not considered at the present time to be economic — of the Witwatersrand system and of the contiguous Dominion reef system of the Ventersdorp Contact reef. It also recommends a systematic geological and geographical survey of formations in other parts of the country deemed to be the equivalents of the Dominion reef series. Although the market for Th is practically nonexistent, it is considered that there will be a long-term market for it once large-scale convertors and breeder reactors come into use. In view of this, a preliminary report of the Republic's Th resources has been compiled. Reserves of monazite in detrital deposits in the Karroo system are calculated at more than 200,000 t containing 7% ThO_2, with another 163,000 t averaging 5.5 to 7.0%. About 30,000 t, averaging 6%, exist in vein deposits in the Vanrhynsdorp district. In addition, large reserves of low-grade uranothorianite are present in the Phalaborwa carbonites. Research into the potential of pegmatites as a source of reactor materials is also discussed. As a logical consequence to the Bufflex U extraction process, the Purlex system has been developed. This applies the same principle, solvent extraction of U directly from leach liquors, cutting out the intermediate ion-exchange absorption step. It appears that the grade of ammonium diuranate does not differ from that obtained from the Bufflex

process, but that a significant saving in reagents can be obtained and possibly better extraction. (BBB)

45267 ABUNDANCE PATTERN OF THE RARE EARTH ELEMENTS IN URANIUM MINERALS. Rao, M. N. (Univ. of Arkansas, Fayetteville). Contract AT(40-1)-3235. Earth Planet. Sci. Lett., 2: 394-6(Aug. 1967).

Distribution patterns of the rare earth elements in samples of uraninite pitchblende, samarskite were studied and an attempt made to understand the regularities of the distribution of the rare earth elements in uraninites and pitchblendes. Eu shows normal abundance in pitchblende but is depleted in uraninites. Although hydrothermal solution deposition is not well established, these solutions are depleted in rare earth elements as a whole. The normal abundance of Eu in pitchblende indicates that the rest solution was subjected to mild oxidation near the surface of the earth and Eu regained the 3+ state. Pitchblende varies between $UO_{2.5}$ and UO_3 and the similarity of ionic radii of Eu^{3+} and U^{4+} seems to help their association. In pegmatic uraninites, crystallization is at the end of magmatic mineralization and Eu is selectively separated from other rare earth elements due to Eu^3 reduction to Eu^2. (F.S.)

Seismology

45268 SIGNAL-GENERATED NOISE RECORDED AT THE ESKDALEMUIR SEISMOMETER ARRAY STATION. Key, F. A. (United Kingdom Atomic Energy Authority, Blacknest, Eng.). Bull. Seismol. Soc. Amer., 57: 27-37(Feb. 1967).

Some seismic data recorded for some nuclear explosions are presented in an investigation of the signal-generated noise at the UKAEA seismometer array station at Eskdalemuir, Scotland. All the signals were recorded on a 20-element unsymmetrical cross array, each line being just over 8 km in length. To obtain an estimate of the low-velocity signal-generated noise at individual seismometers in the array, an event of known simple source function recorded on the array (an underground explosion fired in Nevada on 13th September, 1963, Project Bilby) was processed by a standard method. This involved applying time delays, appropriate to the required bearing and velocity, to each seismometer signal when replayed from the original magnetic tape recording. These delayed signals were summed into 2 groups (semi-sums) which were then band-pass filtered and multiplied. Then the total delayed sum was subtracted from the individually delayed signals, and the relative gains adjusted until the amplitude of the first few cycles reached a minimum. The results demonstrated a close correlation between apparent noise sources and topographic features. A particularly strong local source, in the region of a deep river valley, was found and was studied in detail. (BBB)

45269 A STATISTICAL DISCUSSION OF P RESIDUALS FROM EXPLOSIONS. PART II. Freedman, Helen W. (Univ. of California, Berkeley). Bull. Seismol. Soc. Amer., 57: 545-61 (June 1967).

Data from nearly 60 nuclear explosions (at Eniwetok, Bikini, Algeria, Semipalatinsk, Novaya Zemla, Christmas Island, and the Eastern Pacific as well as for the Chase series in the Atlantic Ocean, and the single explosions Gnome, Salmon, and Longshot) recorded on the Berkeley seismic array of the University of California were studied in an attempt to obtain an estimate of a P travel time adjustment function for each station in the array relative to a standard P table. The probability distribution of residuals is discussed and some error estimates for station adjustments given. A method is suggested for relocating groups of events occurring in small regions. This problem was suggested by the existence of groups of explosions in small regions which gave rise to widely varying sets of residuals. The probable presence of azimuthally varying source, as well as station, terms makes it advisable to obtain times from world-wide stations for each source area in order to attempt to separate the 2 terms. The presence of these terms makes it questionable whether a meaningful adjustment function for a single station can be obtained. The observed variation of residuals with azimuth and distance seemed to be too rapid to be due only to a station azimuth effect or errors in the Jeffreys–Bullen travel-time curve. Each seismic source area seemed to have its own source adjustment function which, data from the Longshot nuclear explosion suggested, may range up to 3 sec. Such functions arise from the variation in crustal and uppermantle structure under each source. (BBB)

45270 A CRUSTAL STUDY IN THE VICINITY OF THE ESKDALEMUIR SEISMOLOGICAL ARRAY STATION. Agger, H. E. (United Kingdom Atomic Energy Authority, Aldermaston, Eng.); Carpenter, E. W. Geophys. J. Roy. Astron. Soc., 9: 69-83(1964).

Measurements of crustal velocities were recorded on a seismological array consisting of 2 lines of Willmore vertical seismometers, brought into operation at Eskdalemuir (Scotland) by the U.K.A.E.A. in May, 1962. The layout is illustrated. Seismic signals from depth charges fired in the North Sea and the Irish Sea were recorded by both the linear array at Eskdalemuir and by a seismometer in a borehole near Durham were analyzed to give information about the regional crustal structure. Arrivals interpreted as refractions from the Mohorovicic discontinuity yielded an estimate of 7.99 ± 0.10 km/sec for the subcrustal compressional wave velocity. The data also yielded depth contours for the Mohorovicic discontinuity, which has a mean depth in the area of about 25 km. In addition to first arrival data the velocity filtering properties of the array were used to identify later phases as multiple reflections which are consistent with the above interpretation. Other arrivals, which were predominantly second arrivals, were interpreted as P_g and yield a crustal compressional wave velocity at 6.12 + 0.06 km/sec. (BBB)

45271 SEISMIC-REFRACTION STUDY OF CRUSTAL STRUCTURE BETWEEN THE NEVADA TEST SITE AND BOISE, IDAHO. Hill, D. P.; Pakiser, L. C. (Geological Survey, Menlo Park, Calif.). Geol. Soc. Amer., Bull., 78: 685-704(June 1967).

A series of reversed seismic-refraction profiles was established from 5 shot points between Eureka, Nevada, and Boise, Idaho. In addition, beginning with the Antler event of September 15, 1961, and extending through events through 1962, recordings of seismic waves generated by various underground nuclear explosions at the Nevada Test Site (NTS) were made along the same general line as far north as Boise. Shot points for the reversed profiles were located near Eureka, Elko, and Mountain City, Nevada, and near Bruneau and Boise, Idaho. Interpretation of the refracted and reflected P events indicated that the crust in the northern Basin and Range province consists of a 6.0-Km/sec layer 19 to 24 Km thick above a 6.7-Km/sec layer 10 to 12 Km thick. Both the crust as a whole and the 6.7-Km/sec layer thicken abruptly at the boundary between the northern Basin and Range province and the western Snake River Plain. The 6.0-Km/sec layer thins across this boundary and may be absent under the Snake River Plain. The crust in the western Snake River Plain consists of a 5.2-Km/sec layer 8 to 10 Km thick over a 6.7-Km/sec layer 33 to 38 Km thick. The upper mantle under both the northern Basin and Range province and the western Snake River Plain has a P velocity of about 7.9 Km/sec. Amplitudes of P_n decrease with the inverse third power of distance and indicate that the upper mantle consists of highly absorptive material or contains a low-velocity layer immediately below the M discontinuity. (BBB)

ENGINEERING

Nuclear Explosions

45272 (AD-642790) MASS FIRE LIFE HAZARD. Final Report. Pryor, A. J.; Yuill, C. H. (Southwest Research Inst., San Antonio, Tex. Dept. of Structural Research). Sept. 1966. Contract N228(62479)68665. 177p. (SWRI-03-1726). CFSTI.

A program was undertaken to define the life hazard in a mass fire environment resulting from nuclear attack. The nature of casualties and hazards in peacetime and wartime fires was reviewed, and experimental efforts to simulate mass fire situations were studied. This state-of-knowledge review revealed a number of areas in need of further definition regarding the true mass fire life hazard. These areas have been specified and limited experimental studies conducted in two of them in order to define their significance with respect to the overall mass fire life hazard. (auth) (TAB)

45273 (ORNL-4145, pp 234-9) CHEMICAL APPLICATIONS OF NUCLEAR EXPLOSIONS. (Oak Ridge National Lab., Tenn.).

Production of cement copper by nuclear fracturing of a copper ore body, in-situ leaching, and recovery of copper from solution by cementation on scrap iron is considered. Simulation of natural gas wells, recovery of oil from shale, and development of hypervelocity jet samplers using nuclear explosions are discussed. (M.C.G.)

45274 (SC-RR-67-616) MAXIMUM MISSILE RANGES FROM SURFACE AND BURIED EXPLOSIONS. Vortman, L. J. (Sandia Corp., Albuquerque, N. Mex.). Sept. 1967. 17p. Dep. CFSTI.

The ballistic boundaries, or maximum ranges of ejected material, for many applicable surface and buried explosions are summarized and scaling expressions are derived which will be helpful in predicting the ballistic boundaries for explosions of other energies. In establishing safety zones it is advisable to multiply predicted boundaries by a factor of 1.5 to 2.0, because of a finite probability that the boundaries observed for a limited number of events will be exceeded if more shots are fired. (auth)

45275 (UCRL-50295) STERLING EVENT: CLOSE-IN PHENOMENOLOGY MEASUREMENTS. Sisemore, Clyde J. (California Univ., Livermore. Lawrence Radiation Lab.). June 29, 1967. 27p. Dep. CFSTI.

The Sterling Event, the first decoupled nuclear shot in the underground detection program, was executed December 3, 1966, at a site near Hattiesburg, Mississippi. In the region near the cavity, measurements of stress history, cavity pressure, particle acceleration, and cavity collapse were made for use in defining and evaluating the parameters controlling the magnitude of the decoupling ratio. Data are presented for the accelerometers, one stress-history gage and the cavity-collapse transducer. Although the acceleration and cavity-collapse data are satisfactory, data from several gages were not recorded; these losses were primarily the result of an unusually large ground loop present in the electronics system. (auth)

45276 COMPARATIVE RADIOACTIVITIES FROM NUCLEAR EXCAVATION. Higgins, Gary H. (Univ. of California, Livermore). J. Constr. Div., Proc. Amer. Soc. Civil Eng., 93: 1-9 (Mar. 1967).

Some technological, economic, and safety problems associated with the use of nuclear detonations for excavation are examined, with emphasis on canal construction. Hazards of nuclear excavation arise from radiation, airblast, and seismic shock. Of these, radioactivity is the most often stressed, but it may ultimately be the least important. An estimate of the radiation hazard is made by comparing the levels of natural radioactivity in dust with the artificial radioactivity that would be introduced into the environment by nuclear excavation. For a 100-kt excavation, the total natural activity in the dust cloud would be 13 Ci. The activity in the 115,000,000 ton of dust from the proposed Transisthmian Canal project would be 10,000 Ci. A table summarizes the comparison of natural radioactivities with those produced by excavation. Radioactivities from excavation are 8 to 15 times greater than those in the average natural background. When the radioactive dust falls back to earth, it is widely dispersed, so that at ranges of several miles the surface inch of soil will contain only one part in several hundred of the fallout dust. Therefore, the average concentration of radioactivities will be increased by only a few percent, at most. (BBB)

Facilities and Equipment

Refer also to abstracts 45247, 45472, 46279, 46893, 46931, 46936, 46974, 46975, 46981, 46982, 46986, and 47041.

45277 (BMwF-FBK-67-03) EINE KERNRESONANZANORDNUNG ZUR MESSUNG UND STABILISIERUNG VON MAGNETFELDERN ZWISCHEN 0,1 G UND 20 kG. (A Nuclear Resonance System for Measurement and Stabilization of Magnetic Fields Between 0.1 and 20 kG). Tatarczuk, J. R. (Max-Planck-Institut fuer Chemie, Mainz (West Germany)). Jan. 1967. 18p. (In German). Dep.

A nuclear resonance system can be built which uses the same principal components as an atomic beam resonance apparatus whereby the atomic beam has been replaced by a flow of a liquid. The technique can be used for the measurement and stabilization of magnetic fields. Since the three fields for the polarization, measurement and detection of polarization are separated from each other the accuracy of the system is constant within a range from 0.1 G to 20 kG. Such a system is described and its properties and limitations are discussed. (auth)

45278 (BNWL-438) DESIGN AND CALIBRATION OF AN ULTRA-HIGH PRESSURE X-RAY CELL. Kulcinski, G. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1967. Contract AT(45-1)-1830. 40p. Dep. CFSTI.

A device to generate pressures up to 50 kbars (~750,000 psi) has has been designed to function in the environment of a nuclear reactor. Its overall cylindrical dimensions are 2.4 cm diam and 3.3 cm long. It has been adapted to yield optical and X-ray information, before and after irradiation, on a sample under pressure. Calibration of this device, by noting the X-ray lattice parameter shift of NaCl and the optical absorption shift of TlBr, is described. It has been shown that the pressure on a powdered sample surrounded by a metallic washer is considerably lower than that predicted by a simple force/area ratio. It is also shown that the pressure gradients on a powdered sample contained between diamond anvils are reduced by surrounding it with a metallic washer. (auth)

45279 (BNWL-465) DESIGN, CALIBRATION, AND CAPABILITIES OF SOLID STATE PISTON-CYLINDER AND "BELT" ULTRA HIGH PRESSURE EQUIPMENT. Kulcinski, G. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1967. Contract AT(45-1)-1830. 26p. Dep. CFSTI.

The general design characteristics of "Belt" and "Piston-Cylinder" high pressure-high temperature equipment capable of pressures to 60 kbar and temperatures to 1500°C are described. The methods of calibrating such equipment by noting resistance changes in cerium, bismuth, thallium, and barium, and volume changes in RbCl and KI, are described in detail. It has been found that for a given load, the pressure on a sample enclosed in a collapsible can filled with a liquid is the same as that determined by noting phase changes in samples imbedded in AgCl sleeves. This result means that calibration curves which have been determined by normal techniques can be used with confidence when using a collapsible can technique for applying hydrostatic pressure. The general capabilities of such equipment are discussed in terms of pre- or postirradiation pressure treatments of materials which are of interest to nuclear metallurgists. (auth)

45280 (N-67-24400) LONG-LIVED RADIOACTIVITY PRODUCED IN NORTHERN OHIO CONCRETE MATERIALS BY NEUTRON ACTIVATION. Myers, Ira T.; Kish, James A. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). May 1967. 12p. (NASA-TM-X-1361). CFSTI.

Measurements were made of trace element concentrations of concrete materials (cement, sand, and gravel) to be used in the NASA Plum Brook Space Propulsion Facility near Sandusky, Ohio. The purpose of the measurements was to select material that would minimize neutron activation of the completed facility during a nuclear test. Exposure rates resulting from best- and worst-case material selection are considered as a function of decay time after a nuclear test is completed. The major activities found after neutron irradiation were due to ^{60}Co, ^{46}Sc, ^{59}Fe, ^{140}La, and ^{24}Na. ^{60}Co was significant only for irradiation times of an order equal to or greater than its half-life. For most projected nuclear tests, ^{46}Sc and ^{59}Fe had the most significant activities. The ratio of cobalt to iron had a value of 0.0045 ± 0.00025 by weight for the materials tested. (auth) (STAR)

45281 (ORAU-101, pp 154-5) AUTOMATED SYSTEM FOR SAMPLE COLLECTION AND COMPUTER ANALYSIS OF THIN-LAYER RADIOCHROMATOGRAMS. Snyder, Fred; Bibler, Donna (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

A system is described that includes an automatic scraper for collecting minute zones of absorbent along thin-layer chromatographic lanes for subsequent radioisotopic or chemical measurements combined with a direct data acquisition system. Remotely

located liquid scintillation spectrometers transmit data by means of a telephone circuit to an IBM 026 card punch. An IBM 7090 computer and an electroplotter are used for graphically producing exact scaled replicas of the radioisotopic distribution along the chromatographic lanes from the punched-card data. The programmed analysis includes the conversion of cpm to disintegrations per minute, the computation of the radioisotopic distribution on chromatograms, recovery of activity from chromatographic plates, and determination of specific activity. (C.H.)

45282 (UCRL-17617) PWM CONTROL OF SERVOMOTOR WITH LINEAR FEEDBACK. Denison, Craig A.; Owen, E. W. (California Univ., Berkeley. Lawrence Radiation Lab.). July 13, 1967. Contract W-7405-eng-48. 13p. (CONF-671107-1). Dep. CFSTI.

For Presentation at Asilomar Conference on Circuits and Systems, Pacific Grove, Calif.

Because of the nonlinear nature of pulse-width-modulated (PWM)-controlled systems, there has been little success in specifying the coefficients for linear feedback to achieve a given performance criterion. One approach has led to a controller that is unrealizable for certain initial conditions, and the response has ripple between the sample instants. The author of another paper has mentioned a method of approximating the time-optimal feedback with linear feedback, but the approximation is unsatisfactory for large initial conditions. A definition for a linear PWM controller is proposed which has, approximately, the minimum response time for a given initial condition, or which can guarantee that there is no overshoot for all initial conditions. (auth)

45283 (BNL-tr-160) CONTENT OF ATMOSPHERIC RADIOLYSIS PRODUCTS IN THE OPERATING CHAMBERS OF POWERFUL GAMMA-RADIATION INSTALLATIONS. Dmitriev, M. T.; Yurasova, O. I. Translated for Brookhaven National Lab., Upton, N. Y., from Gig. Sanit., 32: 112-14(1967). 8p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

The forced-draft ventilating system for the operating chamber of the gamma-irradiator used at the All-Union Research Institute for Canning and Vegetable Drying was investigated. The concentrations of ozone and nitrogen oxides were checked for health protection. The ozone concentration was found to be higher than the maximum allowable concentration. (W.H.K.)

45284 A 50 MILLION NUCLEAR KW YEAR. Bennett, K. W. Iron Age, 200: 59-60(July 27, 1967).

The unexpectedly great demand for nuclear power generating equipment in 1967 is discussed, and the prediction is made that orders amounting to 50 million Kw may be reached during the year. The industry has ordered 18 new nuclear electric power plants through June 30, 1967, whereas 25 were booked in all 12 months of 1966. Long-range predictions for nuclear power have risen from 10 to 20% because of the unexpected higher penetration of the power market by nuclear power. The entire electrical generating market is advancing at unprecedented speed. Until 1965 utilities usually installed <20 million Kw of new capacity per year. In 1966, the industry placed orders for 43 million Kw of new capacity, and by June 30, 1967, 39.5 million Kw had been ordered. Equipment producers can not supply new plants before 1973, and orders are already being placed for 1974 delivery. Of the new generating capacity, about 55% is nuclear powered. A description is given of some individual nuclear plants. (BBB)

45285 DEPRESSURIZATION TIMES FOR A GAS-FILLED VESSEL WITH FRICTIONLESS DISCHARGE THROUGH A BREACH. Wall, W. A. J. (United Kingdom Atomic Energy Authority, Risley). J. Brit. Nucl. Energy Soc., 6: 233-40(July 1967). (AHSB(S)R-132).

Frictionless gas discharge from a vessel is considered for the two cases involving either adiabatic or isothermal expansion within the vessel. Formulas for the depressurization times to particular states either in the sonic or subsonic discharge regions are derived, and curves are supplied for the determination of times for complete depressurization to atmospheric pressure for carbon dioxide and helium with constant expansion indices. (auth) (UK)

45286 COLLISION PROBLEMS IN ATOMIC NAVIGATION. Woisin, G. (C. Schroedter and Co., Hamburg). Hansa, No. 12, 1-12(1964). (In German).

The task of building a nuclear ship as collision safe as possible is considered under the following five viewpoints: unsinkability, possible subjection of the ship to acceleration in the collision, strengthening of the hull construction in the vicinity of the reactor, arrangement construction and support of the constituents in the safety vessel, and the arrangement of the reactor installation in the ship. The size of the destruction energy was calculated and the hydrodynamic supplementary magnitudes are considered. The statistical analysis of Minorsky is outlined. The bending of the entire ship body is considered. The collision research necessary to improve the approximations are outlined. Methods for implementation of collision safety are given. (J.S.R.)

45287 SUPERVISORY CONTROL OF REMOTE MANIPULATION. Ferrell, William R.; Sheridan, Thomas B. (Massachusetts Inst. of Tech., Cambridge). IEEE (Inst. Elec. Electron. Eng.), Spectrum, 4: 81-8(Oct. 1967).

The relatively short distances to be spanned in using the manipulators presently available permit real-time control systems, frequently employing direct linkages. The advent of space flight necessitates the design of manipulation systems that can perform complicated tasks, on the moon and beyond, upon command from earth. Such a design must compensate for the communications time delay due to the distances involved and also for a difference in environment not directly observable by the human operator. The answer to the problem seems to lie in a computer-controlled remote unit, capable of making limited decisions of its own but supervised from home base. (auth)

45288 ENGINEERING ASPECTS OF A NUCLEAR DESALTING PLANT. Perri, Joseph G. (Burns and Roe, Inc., New York). J. Power Div., Proc. Amer. Soc. Civil Eng., 93: 31-50 (Mar. 1967).

Some new engineering features and problems presented by the design and construction of dual purpose desalination and nuclear power plants are discussed. They represent a transformation of the simple nuclear power and desalting plants that are being designed all over the world, but contain new main elements conceptually different from the analogous elements found in those simple plants and exhibiting special characteristics of considerable importance in the operational design of a modern desalination plant. One of the most important characteristics of the plant is the multistage controlled evaporator, i.e., the complex of stages vertically assembled containing thin film evaporators for the conversion of saline waters. The problem posed by the modular concept required considerable study and technical background, but the resulting coordinate procedure for the general assembly of the modules will produce a vessel-structure concept. The structural system is described. Basically, it can be classified as an orthotropic plate system, however, its dual function of being a pressurized vessel and a supporting structure makes it an unusual engineering project. (BBB)

45289 PATTERNS OF U. S. ENERGY CONSUMPTION TO 1980. Vogely, William A.; Morrison, Warren E. IEEE (Inst. Elec. Electron. Eng.), Spectrum, 4: No. 9, 81-6(Sept. 1967).

The total consumption of energy in the United States in the year 1980 is expected to be equivalent to 93×10^{18} joules or 63 percent greater than in 1965. Coal consumption in 1980 is projected at 612 to 677 million tonnes, natural gas at 696,000 million cubic meters, and petroleum products demand at 899 million tonnes. Nuclear power generation will be 723 million MWh; conventional fuel-burning plants will provide up to 1941 million MWh of energy. (auth)

45290 IMPROVEMENTS IN OR RELATING TO MIXER-SETTLER APPARATUS. Alexandre, Denis; Auchapt, Pierre; Bouzou, George; Mazoyer, Bernard; Milhes, Jean; Sarrat, Pierre (to Commissariat a l'Energie Atomique). British Patent 1,087,198. Oct. 11, 1967. Priority date Sept. 19, 1963, France.

A mixer-settler is described which may be used in separating uranium from fission products by contacting an aqueous solution containing uranium and fission products with an organic phase such as tributylphosphate diluted by an inert solvent or plutonium may be separated from an aqueous acidic solution containing impurities by contacting it with the same organic phase. The apparatus is easy to manufacture, requires little or no adjustment, is safe, and consists of sub-critically dimensioned mixing and settling sections and frusto-conically shaped agitators. The stages are linearly arranged with mixers receiving the material to be contacted from the settler in which the mixture was previously settled. (F.S.)

45291 IMPROVEMENTS IN OR RELATING TO DEVICES FOR LIFTING ARTICLES. Friars, Frederick William; Bolling, Robert Walker (to United Kingdom Atomic Energy Authority). British Patent 1,087,076. Oct. 11, 1967. Filed Jan. 17, 1964.

A remotely operated lifting device is described which is used primarily for handling reactor fuel elements which are equipped with a method for engagement by a lifting device. Fissonable material in the fuel element is enclosed in a protective sheath which is contained in a graphite sleeve. The lifting device is capable of lifting and supporting an object within a narrow chamber and consists of an elongated support member, a load member aligned or parallel with the support member, and a number of tongs. (F.S.)

45292 IMPROVEMENTS IN OR RELATING TO METHODS OF AND APPARATUS FOR EVAPORATING LIQUIDS. Messainguiral

Lucien; Franchi, Jean; Scheidhauer, Jean (to Commissariat a l'Energie Atomique). British Patent 1,086,318. Oct. 11, 1967. Priority date Oct. 9, 1963, France.

A method and apparatus are described for evaporating large quantities of liquids such as those in radioactive solutions so that alpha and beta measurements can be made. A flexible deformable membrane is placed on a receptacle defining, with the base, a sealed compartment in which a vacuum forms. The solution to be evaporated is placed in the compartment. A stream of gas is circulated above the membrane and the vacuum is maintained until evaporation is complete. This method of evaporation is most effective for liquids having a low surface tension which prevents the formation of a permanent drop of liquid. (F.S.)

Heat Transfer and Fluid Flow

Refer also to abstracts 45308, 45309, 45311–45313, 45456, 45865, 46289, 46976, 46978, 46987, and 46988.

45293 (AAEC/E–182) SIMPLIFIED THEORY OF MEASUREMENT OF HEAT TRANSFER COEFFICIENTS WITH TRANSIENT TECHNIQUES. Hart, J. A.; Szomanski, E. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). July 1967. 15p. Dep.

A simplified approach to the theory of transient convective heat transfer is outlined. Analytical solutions for some cases of substantial interest in surface heat transfer coefficient measurement are obtained. Comparisons with results of previous workers indicate that this new approach leads to exact solutions. (auth)

45294 (ORNL-TM–1896) HYDROMAGNETIC STABILIZATION OF JET-DRIVEN VORTEX FLOW. Keyes, J. J. Jr.; Chang, T. S.; Sartory, W. K. (Oak Ridge National Lab., Tenn.). Oct. 1967. Contract W-7405-eng-26. 72p. Dep. CFSTI.

Confined, vortex-type flows generated by tangential impingment of fluid on the interior surface of a tube are observed to be unstable at values of tangential Reynolds modulus much below the range of interest for such advanced energy conversion applications as the gaseous fueled nuclear reactor and the vortex magnetohydrodynamic power generator. At the operating temperature level envisioned for these devices, however, the electrical conductivity may be sufficiently high that magnetohydrodynamic stabilization can be considered. Experiments are described which demonstrate the stabilizing influence of an axial magnetic field (up to 75 kilogauss) on vortex flow of an aqueous electrolytic conductor generated by two-dimensional, tangential wall jets. For example, using a 10-cm-dia vortex tube having two feed jets and a single exit orifice at the center of one end, the tangential Reynolds modulus at transition to instability was increased from 500 with no magnetic field to 7600 with the 75 kilogauss field (corresponding to a Hartmann modulus based on the tube radius of 172). The experimental magnetic stabilization results for 1-, 2-, and 4-slit injection are correlated in terms of a modified Goertler modulus [tangential Reynolds modulus based on momentum boundary-layer thickness times (momentum thickness/radius)$^{0.43}$] and the Hartmann modulus based on momentum thickness. An MHD Goertler-type stability analysis based on a tangential jet-injection velocity profile over a concave wall is considered. The fluid medium is assumed to be incompressible, viscous, and electrically conducting. The stationary jet-injection velocity profile is calculated according to the classical theory of laminar boundary-layer flow, neglecting effects of curvature. The stability analysis is carried out numerically based on the linear perturbation theory for the calculated stationary profile subjected to an external magnetic field. Whereas the jet-velocity recovery ratios (tangential velocity extrapolated to wall/mean injection velocity) derived from the theoretical stationary velocity profiles agree well with the measurements for magnetically stabilized vortex flow, the agreement between results of the stability analysis and the measurements is poor. Possible reasons for the disagreement are discussed. (auth)

45295 (TID–23737, pp 231-329) BIBLIOGRAPHY AND DISCUSSION OF FLOW MEASUREMENT BY SALT-DILUTION AND SALT-VELOCITY TECHNIQUES (TURBULENT DIFFUSION OF SOLUBLE TRACERS). Filmer, R. W.; Yevdjevich, V. M. (Colorado State Univ., Fort Collins. Engineering Research Center).

A bibliographical survey was made of salt-dilution and salt-velocity techniques for measuring flows in streams and pipes. Brief descriptions of both techniques are given. (204 references are listed.) (L.C.L.)

45296 (UJV–1813) ISSLEDOVANIE MESTNYKH KOVFFITSIENTOV TEPLOOTDACHI V KOL'TSEVOM KANALE S TSEL'YU OPREDELENIYA VLIYANIYA EKSTSENTRICHNOSTI NA POLE TEMPERATUR. (Studies of Coefficients of Local Heat-Transfer in a Ring Channel in Order to Determine the Effects of Excentricity on the Temperature Field). Shul'ts, V. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). May 1967. 59p. (In Russian).

The measurement of the effects of eccentricity on the value of the local heat transfer coefficients in ring channels in the region of the Re, Pr, and Pe numbers under the geometric conditions given showed that the local heat transfer coefficients differ very little from the value $\bar{\alpha}$, and, with decrease of the width of the channel, α_c increases some and is somewhat decreased with increasing width. Some reduction of the mean heat transfer coefficient is observed. (tr-auth)

45297 (UJV–1815) ISSLEDOVANIE LOKAL'NOI TEPLOOTDACHI I TEPLOVYKH POLEI U 7-STERZHNEVOGO PUCHKA V OSEVOM POTOKE NATRIYA. PLOTNOST' RESHETKI s/d-1,2. (Studies of Local Heat Exchange and Heat Fields in 7-Rod Bundle in Axial Sodium Flux. Density of the s/d-1,2 Lattice). Pashek, M. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). May 1967. 27p. (In Russian). Dep.

Experimental heat transfer results were obtained for the case of a long streamlined 7-rod bundle with a lattice in the shape of a right triangle and having a density of S/d of 1.2 at lower Pe numbers. All 7 rods were electrically heated in order to obtain a constant thermal flow of 31.9 kcal/m^2-hr. The investigations were carried out in the experimental area located in the sodium loop with an effective rod length of 1 to 850mm. and l/d of 133. The measurements were carried out for the following conditions: mean rate of Na flow = 0.22 to 1.8 m/sec., Re = 2.6×10^3 to 14.7×10^3, Pe = 21 to 120, and Pr = 7.7×10^{-3} to 7.9×10^{-3}. At constant temperature, the central thermal field has an l/d of 97 and at the thermal-field entrance the field has an l/d of 15.7 at various Pe numbers. The discovered temperature variation effect around the rod bundle increases with decreasing Pe, and it was shown that this variation, taking place in the transition flow regime ($20 < Pe < 80$), is significant in the start-up of fast neutron reactors. At low sodium flow rates, e.g., Pe = 10, $q \sim 10^5$, the temperature differential around the fuel element is 30°C. The variation of local heat transfer coefficient and the Nu number for different regimes of fluid flow were investigated. (tr-auth)

45298 (NP-tr–1570) THERMAL FIELDS AND HEAT FLUXES. PART I. GRAPHICAL STUDY OF STEADY AND VARIABLE CONDITIONS. CHAPTER III. GRAPHICAL METHODS FOR VARIABLE CONDITIONS. 1. LINEAR THERMAL FIELD AND UNIDIRECTIONAL HEAT FLOW THROUGH A WALL. Translated by J. W. Newmarch Holmes (Atomic Energy Research Establishment, Harwell, Eng., from Bull. Tech. Soc. Fr. Constr., Babcock et Wilcox, No. 23, 73-119(1950). 113p. (In English and French). CFSTI. JCL $9.60 fs, $3.59 mf.

Includes original.

A method is described for graphically representing the instantaneous temperature distribution and heat flux densities in a wall under variable conditions. The principles of construction for the diagrams are given, including means of accounting for variable conditions. Diagrams which resulted from this method are shown. (L.C.L.)

45299 SLUG FLOW AND FILM BOILING OF HYDROGEN. Chi, J. W. H. (Westinghouse Electric Corp., Pittsburgh). J. Spacecraft Rockets, 4: 1329-32(Oct, 1967).

Forced convective, transient boiling heat transfer was studied by the cooldown of a copper test section by liquid hydrogen. From the slopes of the local wall temperature histories, local forced convective boiling heat flux was obtained for a wide range of conditions. The fluid temperature traces showed well-behaved oscillations with the following characteristics: a high-frequency, low-amplitude oscillation attributed to mist flow was seen to be superimposed on a low-frequency, high-amplitude oscillation due to slug flow. Based on the bulk stream temperature traces and the apparent mechanisms of two-phase flows, a general equation was derived for forced convective film boiling heat flux; $q/A = (1 - X_{TP})h_v(T_{wi} - T_v) + X_{TP}h_f(T_{wi} - T_f) + X_{TP}(q/A)_{Bo}$ where X_{TP} is the time fraction of two-phase flow, referred to slug flow; h_f and h_v are the heat-transfer coefficients for gas film and vapor, respectively; T_f and T_{wi} are gas film and inside wall temperatures, respectively; T_v is the average superheated vapor slug temperature; and $(q/A)_{Bo}$ is the boiling flux component given in a previous note. The equation correlated the data with an average deviation of ±21%. A correlation also was developed for X_{TP} which is given as a function of the boiling number, $(q/A)_{Bo}/G\lambda$; $X_{TP} = 3.72 \times 10^{-5}[G\lambda/(q/A)_{Bo}]^{1.2}$. It was shown that the correlations are applicable to single phase gas, mist flow, slug flow, and annular flow. (auth)

45300 HEAT EXCHANGE IN A CHANNEL WITH DENSELY PACKED TUBE OR ROD BUNDLES. Koshkin, V. K.; Kalinin,

E. K.; Yarkho, S. A.; Ter-Mkrtchyan, A. A. (Moscow Aviation Inst.). Teplofiz. Vys. Temp., 5: 317-21(Mar.-Apr. 1967). (In Russian).

Experimental studies were made of the heat transfer in water at Re = 8×10^3 to 10^5 range at constant heat release along the length and perimeter of a channel. The results obtained and the method for field temperature calculations in the structural elements forming the tightly packed tubes or fuel rods are discussed. (tr-auth)

45301 NONCONVENTIONAL CYCLES FOR THE COMBINED PRODUCTION OF POWER AND LOW-TEMPERATURE HEAT. Angelino, Gianfranco (Politecnico, Milan). Calore, 37: 365-81 (1966). (In Italian).

The reasons for renewed interest in nonconventional fluids in power production are illustrated. A particular cycle for the simultaneous production of energy and low temperature heat using an organic compound as the working fluid is presented. An analysis of the calculations is presented which shows that the advantages obtained from this solution reside primarily in the low pressure regime, high efficiency and simplicity of the primary motor and recuperator. The primary disadvantages are represented by the cost of the fluid whose thermally degraded fractions must be continuously replaced and by sealing problems. The comparison with a conventional regenerative steam cycle makes it possible to evaluate quantitatively the improved performance of the cycle proposed. The choice of a suitable working liquid is recognized as the chief problem with respect to future applications. The results of a preliminary investigation are presented. From these results it appears that the most promising organic compounds are to be found among those fluorocarbons with a high degree of thermal stability and chemical inertness. The temperature levels at which these organic fluids can be used coincide approximately with the temperature levels at which most nuclear reactors today operate. The radiation stability which characterizes the entire class of fluorocarbons makes the coupling of the proposed cycle to a power reactor attractive. (tr-auth)

45302 BOILING BURNOUT: A REVIEW OF RECENT WORK. Lee, D. H. Brit. Chem. Eng., 12: 1363-8(Sept. 1967).

Developments in boiling water burnout over the past three years are reviewed. The trend of the various parameters affecting burnout is described, together with a summary of sources of data for tubes, annuli, and rod clusters. Correlations for predicting burnout in these geometries are presented, and mention is made of a new technique which uses other fluids at low pressure to simulate quantitatively burnout with high pressure water. Selected references are given for recent developments in two-phase flow, pressure drop, natural circulation boiling, and wetting of hot surfaces. (UK)

45303 ANALYSIS OF TRANSIENT TEMPERATURES IN GAMMA-HEATED MATERIALS. Rumpf, N. K.; Mingle, J. O. (Kansas State Univ., Manhattan). J. Spacecraft Rockets, 4: 1195-9(Sept. 1967).

The heating of a slab by a plane beam of gamma radiation is analyzed to determine the resultant transient, spatial temperature distribution. When exposed to the 9.5×10^4 Btu/hr-ft^2 of radiation expected near unshielded high-power nuclear rocket reactors, steel in thicknesses ≥ 0.25 in. would remain intact, but aluminum would melt in a few hours. Boundary conditions were an insulated face near the source and gray body thermal radiation to 500°R on the far surface. Another mathematical model, representing the auxiliary cooling of structural rocket materials by the use of bleed gas, was employed by assuming that the previous slab is split into two parts with convective cooling in the cut. This analysis showed that the temperatures would be significantly reduced. (auth)

Isotope Technology

Refer also to abstracts 45028, 45447, 45448, and 45995.

45304 (AD-632991) SNAP-7A ISOTOPIC POWER SUPPLY FOR BUOYS. Test Report. Wesler, J. E. (Coast Guard, Baltimore, Md. Field Testing and Development Center). Mar. 2, 1966. 21p. CFSTI.

One SNAP-7A system was evaluated for approximately four years since its original delivery. The performance of the SNAP-7A system deteriorated much more rapidly than predicted, so that its performance after four years is below that predicted at the end of its expected ten-year life. The fault appears to be a deterioration, of the thermoelements in the thermoelectric generator of the system. (auth) (TAB)

45305 (AD-640660) EVALUATION OF IRRADIATED WOOD-PLASTIC COMBINATIONS FOR USE AS GUN STOCKS. Jennings, E. A.; Eisler, S. L. (Army Weapons Command, Rock Island, Ill. Research and Engineering Div.). Sept. 1966. 16p. (RIA-66-2791). CFSTI.

Wood-plastic combinations were prepared from four wood species: white pine, yellow pine, maple, and walnut by impregnation with methyl methacrylate and subsequent exposure to gamma radiation. Results of static bending, hardness, and toughness tests showed no appreciable improvement in the properties beyond those of the untreated walnut. Furthermore, increased weight and cost indicate that wood-plastic materials prepared from readily available cost woods would not serve as suitable substitutes for walnut gun stocks. (auth) (TAB)

45306 (CEA-Bib-94) LISTE NON EXHAUSTIVE DE REFERENCES A DES TRAVAUX FRANCAIS PUBLIES EN 1965 ET 1966 DANS LE DOMAINE DES APPLICATIONS INDUSTRIELLES DES RADIOELEMENTS. (Nonexhaustive List of References to French Work in the Field of the Industrial Applications of Radioelements in 1965 and 1966). (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Sept. 1967. 22p. (In French). Dep.

A bibliography of 186 references, which is incomplete and covers only two years, gives an idea of the importance of French work in the field of the industrial applications of radio isotopes. Included are references on analysis, hydrology and sedimentology, but not biological and medical applications. The C.E.A. contributed 100 references; of this number, 29 correspond to C.E.A. notes (CEA-N) which are not prepared with a view to being widely distributed but have been judged to be of interest and to represent an important part of the work of the Radioisotope Application Section. (tr-auth)

45307 (SC-CR-67-2656) STUDY OF THE CHEMICAL INTEGRITY OF RADIOISOTOPE CONTAINMENT MATERIALS IN LAUNCH ABORT ENVIRONMENTS. SUMMARY TECHNICAL REPORT, PHASE III, TASK I: THE BEHAVIOR OF CONTAINMENT MATERIALS IN HYDROGEN–FLUORINE FLAME ENVIRONMENTS. Gregson, W. Jr.; Ogren, J. R.; Ham, R. C. (TRW Systems Group, Redondo Beach, Calif.). June 1967. Contract 48-4912. 93p. Dep. CFSTI.

For Sandia Corp. [Albuquerque, N. Mex.]

The behavior of four nuclear containment materials (Type 316 stainless steel, Hastelloy C, Haynes alloy 25, and tantalum) in simulated abort fires containing large concentrations of fluorine and hydrogen fluoride were investigated. Samples were exposed to hydrogen–fluorine flames of two mixture ratios over a wide range of steady state sample temperatures. Metallographic analysis of some samples were performed to determine the degree of internal interaction for both fluorine and hydrogen rich flame environments. Electron microprobe and x-ray diffraction techniques were used to identify reaction products in the microstructure of certain samples. (auth)

45308 (TID-23737) DISCHARGE MEASUREMENT USING RADIOISOTOPES IN HIGH HEAD TURBINES AND PUMPS. Annual Report, Fiscal Year 1966. Hansen, R. L.; Schuster, J. C. (Bureau of Reclamation, Denver, Colo.). Sept. 30, 1966. Contract AT(49-11)-2758. 329p. Dep. CFSTI.

Six papers on tracer techniques for measuring fluid flow in pipes, in streams, and in turbines are presented. Separate abstracts were prepared for each, including the three appendixes. (L.C.L.)

For abstracts of individual papers see: 45295 and 45309–45313.

45309 (TID-23737, pp 1-86) DISCHARGE MEASUREMENTS USING RADIOISOTOPES IN HIGH-HEAD TURBINES AND PUMPS (FISCAL YEAR 1966). (Bureau of Reclamation, Denver, Colo.).

A program was undertaken to develop techniques for using radioactive tracers to measure the water flow through high pressure turbines and other hydraulic machines. A literature search produced about 300 references on tracer techniques for flow measurement. Theoretical and experimental hydraulic studies of tracer diffusion in flowing water were made and resulted in the development of preliminary methods for determining diffusion coefficients and pipeline lengths required for tracer-water mixing. Radioisotopes were investigated to determine the best tracer, detection method, and the method of computing the total flow. A field test was performed in a 320-ft-long, 10-ft-dia, high-head turbine penstock of Flamming Gorge Dam near Vernal, Utah. The injection, sampling, and procedures necessary for making radioisotope discharge measurements in high-head installations were studied. These tests showed that good mixing does not occur in a pipeline length of about 30 dia for a single jet of isotope introduced at 0.3 of the radius of the pipe wall. Continued work in this field is recommended. (L.C.L.)

45310 (TID-23737, pp 87-113) ISOTOPE TECHNIQUES IN HYDROLOGY. Working Group Meeting held at Grenoble, France, 25–28 October 1965. (International Atomic Energy Agency, Vienna (Austria)).

In connection with research programs jointly sponsored by the AEC and the Bureau of Reclamation, a Bureau representative traveled to Grenoble to participate in a 4-day working group meeting on the isotope techniques in hydrology. The discussions were of an informal type emphasizing recent developments and current problems, and covered such applications as radioisotopes flow measurement in streams and canals, reservoir leakage, groundwater tracing, sedimentation studies, soil density and moisture measurements, and meteorology. Subsequent to the panel meeting, selected visits to organizations concerned with, or performing, flow measurements in high-head turbines and the general engineering applications of radioisotopes were made. A great deal was learned of work being done in flow measurements of radioisotopes at the EDF laboratories at Chatou and the Wantage Laboratory in Great Britain. (auth)

45311 (TID-23737, pp 115-32) A LITERATURE SURVEY OF RADIOISOTOPES SUITABLE AS TRACERS FOR MEASURING FLOW RATES OF WATER IN HIGH-HEAD TURBINES AND PUMPS. McCormick, G. H. (Denver Research Inst., Colo.). (DRI-2315).

A literature survey was conducted to determine which radioisotopes may be suitable for water flow measurements in turbines and pumps. The isotopes desired should be gamma emitters and have half-lives in the range of one to nine days. Sufficient biological data should be available to permit their safe use. A total of ninety-one gamma emitting isotopes were found that have half-lives in the desired range. Of these isotopes there are sixteen with biological data recorded and eleven of these are commercially available. (auth)

45312 (TID-23737, pp 133-44) DEVELOPMENT OF RADIO-RELEASE TECHNIQUE FOR MEASUREMENT OF TURBINE DISCHARGE. Richter, Harold G. (Research Triangle Inst., Durham, N. C.).

A new radio-release analysis technique for continuously measuring the water flow through turbines is described. This method would improve the accuracy of the flow measurements and, therefore, the accuracy of the turbine efficiency calculations. Radio-release analysis is a technique which detects stable ions by their ability to release radioactive species from a second physical or chemical phase. It has the advantage that radioactivity is not added as tracer to the stream flow being measured. Radioactivity is used only in the analysis after the stream flow samples have been collected. Specific metals such as cadmium, hafnium, indium, tantalum, zinc, and zirconium are suggested for use as tracers. Details of the proposed work project are given. (L.C.L.)

45313 (TID-23737, pp 145-230) USE OF TRACERS IN MAKING ACCURATE DISCHARGE MEASUREMENT IN PIPELINES. Filmer, R. W.; Yevdjevich, V. M. (Colorado State Univ., Fort Collins. Engineering Research Center).

An investigation was made to provide some field data for the diffusion of a soluble tracer (Rhodamine W-T) in pipes. Nine parameters were selected and their effects on tracer concentration distribution were studied. The most important parameters varied were: water discharge through the pipe, mixing distance and the injection probe geometry. The experiments were conducted in a 36-inch pipe line where it was possible to vary the rate of flow and mixing distance. Uniformity of the rate of dye injection was ensured by the use of a Chemcon Model 1110 chemical proportioning pump which could be manually adjusted while a radial arm, some distance downstream from the injection point, could sample the solution at different positions in a cross-section. A Turner model 111 fluorometer constituted the detection device which combined the advantages of high sensitivity in dye detection, ruggedness and nearly complete independence from the power supply voltage. The degree of uniformity of mixing of the soluble tracer is represented by C_v, which is the coefficient of variation of the tracer concentration distribution. Values of C_v, calculated from the observed concentration data for each flow rate, were fitted by the function $C_v = Ke^{\alpha Z}$ by the method of least squares, where z is the mixing distance and K and α are constants. (auth)

45314 (JPRS-42391) USE OF RADIOISOTOPES AS POWER SOURCES. Translated from Nucleus (Paris), 8: 266-70(1967). 9p. (TT-67-33020). CFSTI.

The use of isotopic generators to produce electrical energy is described. Three types of generators are recommended for European use. These are high-power fission product generators combined with conversion equipment for land use; radioisotope batteries for medical and industrial use, and high-performance generators using ^{238}Pu and ^{227}Ac. Economic evaluations of isotopic generators for space and terrestrial applications are made. (F.S.)

45315 THE BETA SELF-ABSORPTION OF ^{63}Ni AS METALLIC NICKEL. Sims, G. H. E.; Juhnke, D. G. (Atomic Energy of Canada Ltd., Ottawa). Int. J. Appl. Radiat. Isotop., 18: 727-8(Oct. 1967).

Nickel-63 is a low-energy beta-emitter (end-point energy 0.067 MeV) with a half-life of 120 yr. The fact that nickel can be spread in uniform thin layers by standard plating techniques gives ^{63}Ni a distinct advantage over other low-energy beta-emitters as a potential source in ionization gages and thickness gages. Since ^{63}Ni is a very low-energy beta-emitter a critical factor in the performance of these gages will be the beta absorption coefficient of ^{63}Ni. Self-absorption coefficient values of 1.56 cm^2/mg for plated nickel metal have been reported. In view of the potential importance of ^{63}Ni-plated sources, confirmation of this value was desirable. Four plating solutions containing ^{63}Ni of different specific activity were used to improve the statistical accuracy of the result and to confirm that the specific activity of the ^{63}Ni had no effect on the self-absorption coefficient. Agreement was found with the above value. (auth) (UK)

45316 DESIGN OF A ^{60}Co LABORATORY IRRADIATION INSTALLATION USING A DISCARDED 1000-Ci THERAPY APPARATUS. Markus, Benno; Kasten, Gerhard (Univ., Goettingen, Ger.). Strahlentherapie, 133: 459-64(July 1967). (In German).

The design is described of a ^{60}Co irradiation unit with a fixed beam direction consisting of a cylindrical lead container with a radial opening. The source can be put into working position by certain devices which can rotate and displace the source. Barium-concrete is used to support the protective container. A cavity in this concrete serves as the irradiation space. The material to be irradiated is introduced through a channel with lead cover. The room containing the ^{60}Co unit does not require an additional radiation protection and, thus, limits the control area. Details as well as costs are reported. (auth)

45317 MAJOR SYSTEM DESIGN PROBLEMS FOR DEEP SPACE PROBES. Dixon, William J. (TRW Systems, Redondo Beach, Calif.). J. Spacecraft Rockets, 4: 1121-7(Sept. 1967).

Major problem areas of system design are defined and considered for deep space probes for first-generation, unmanned exploration of the outer planets of the solar system. Such missions are feasible within current launch vehicle performance and spacecraft technology, but system designs must accommodate the extreme distances from the Earth and Sun, the long flight times, and the uncertain or unknown environments characterizing these missions. The resulting problem areas are identified and available alternate approaches are reviewed. Radioisotope thermoelectric generators are preferred sources of onboard power. Lower power-to-weight ratios and long transmission distances lead to large communication antennas to produce reasonable downlink data rates. Antenna pointing requirements favor an Earth-pointing cruise orientation; this can be achieved by either spin- or three-axis-stabilization concepts. Either approach may be compatible with the pointing and control requirements for propulsive maneuvers and the scanning requirements of scientific instruments. A progression in system requirements is outlined, from simple concepts with modest payloads for flyby missions to orbiters that are appropriate for science payloads over 100 lb. Swingby missions to Uranus, Neptune, and Pluto offer advantages in launch energy and mission time, but entail more complex trajectory guidance and control requirements. (auth)

45318 ABSTRACTS OF THE 3RD ANNUAL MEETING ON RADIOISOTOPES IN THE PHYSICAL SCIENCES AND INDUSTRY [TOKYO UNIVERSITY, APRIL 19-21, 1966]. [Tokyo, Tokyo Univ., 1966]. 166p. (In Japanese and English). (CONF-660454).

One hundred and ten abstracts of papers given at the 3rd Annual Meeting on Radioisotopes in the Physical Sciences and Industry, held in Tokyo in April 1966, are presented. (L.C.L.)

45319 ISOTOPES AND RADIATION TECHNOLOGY. Volume 4, Number 2. Baker, P. S.; Lafferty, Robert H. Jr.; Gerrard, Martha; Greene, R. E.; McKinney, F. E.; Carden, Joan E.; Rupp, A. F. (eds.). Contract W-7405-eng-26. One of the five Quarterly Technical Progress Reviews published for the Division of Technical Information, USAEC. Oak Ridge, Tenn., Oak Ridge National Lab., Winter 1966-1967. 128p. GPO $0.70 Domestic, $0.90 Foreign.

Research and development sponsored by the Division of Isotopes Development are related to significant developments in radioisotopes and radiation technology, as reported in the world literature. Coverage includes isotope production and development, isotope technology development, isotope applications technology, process radiation development, and radiation processing of foods. Seventeen papers are included, 13 of which are abstracted in NSA. (M.M.B.)

For abstracts of individual papers see: 45027, 45028, 45152, 45154, 45155, 45320-45322, 45439, 45460, 45512, 45685, and 45858.

45320 ISOTOPE PRODUCTION AT GENERAL ELECTRIC'S VALLECITOS NUCLEAR CENTER. Howard, N. C. (General Electric Co., Pleasanton, Calif.). Isotop. Radiat. Technol., 4: 77-82(Winter 1966-1967).

The radioisotope production facilities of General Electric's Vallecitos Nuclear Center, Pleasanton, Calif., are described. Details of the General Electric Test Reactor presented include neutron-flux data, isotope production positions in the core, hydraulic shuttles, and cable devices for irradiation alongside the core. Postirradiation procedures and a summary of currently produced radioisotopes are also given. (auth)

45321 CONTAINERS FOR TARGETS IN PRODUCTION OF RADIOISOTOPES IN SWIMMING-POOL REACTORS. Harvey, H. W.; Hoh, J. C.; Mohr, W. C.; Stewart, D. C. (Argonne National Lab., Ill.). Isotop. Radiat. Technol., 4: 82-3(Winter 1966-1967).

One inexpensive can, of three types tested, was found to be possibly suitable for use as a target container in the production of radioisotopes in a swimming-pool reactor. (auth)

45322 INTERNATIONAL STUDY OF TERRESTRIAL APPLICATIONS OF RADIOISOTOPIC POWER SOURCES. Carden, Joan E. Isotop. Radiat. Technol., 4: 172-82(Winter 1966-1967).

The existing and some potential terrestrial applications of radioisotopic power sources are discussed in the draft report of an international Study Group sponsored by the International Atomic Energy Agency and convened in Vienna, Austria, July 11 to 15, 1966. The Study Group emphasized the applications and health and legal aspects of terrestrial radioisotopic power sources and considered conversion systems, radioisotope selection, and alternative energy sources. (auth)

Materials Testing

Refer also to abstracts 45278, 45279, 46928, and 46973.

45323 (SC-CR-66-2135) A STUDY OF IMPACT EFFECTS ON SPHERICAL SHELLS. PART I. A THEORETICAL STUDY OF THE RESPONSE OF HOLLOW CYLINDERS TO IMPACT LOADS. Oline, Larry W.; Stoneking, Charles E. (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Nov. 1966. Contract 48-0521. 104p. Dep. CFSTI.

For Sandia Corp., Albuquerque, N. Mex.

The structural integrity of cylindrical shells under high velocity axial impact is investigated. A modified strain-rate theory is proposed to describe the material above the elastic limit. A failure criterion is established and investigated for various lengths, radius-to-wall thickness ratios and impact velocities. Results are compared with experimental data. The application of a shell theory with shear, bending, and radial inertia was also investigated. The failure velocities determined from the plastic membrane theory are below those of the corresponding experimental results As the wall thickness to radius ratio becomes smaller, the cylindrical shell becomes closer to a true membrane for which the theory was designed and in general the difference between the theoretical and experimental results decreases. The bending theory was investigated to compare the results with the elastic membrane theory and to show the buckling deformation developing. There was no expectation that the strictly elastic theory would predict failure velocities. The bending theory essentially oscillates about the membrane theory. The results were inconclusive but the general rippling type deformation was observed. (auth)

Protective Structures

Refer to abstract 46990.

Radioactive Material Handling

Refer also to abstracts 45287, 45367, 45868, 46902, 46974, and 46983.

45324 (ORNL-4145, pp 303-8) SAFETY STUDIES OF FUEL TRANSPORT. (Oak Ridge National Lab., Tenn.).

A program was organized to develop an acceptance criteria for casks designed for transporting irradiated fuel. The intent is to provide a uniform engineering basis for cask design and fabrication that will ensure compliance with the performance specifications imposed by AEC regulations. The criteria will consider engineering standards for the design, fabrication, testing, and analysis of shipping casks for irradiated fuel. It will provide a uniform basis for assessing design adequacy without inhibiting the ingenuity or technical aggressiveness of the designer. Data and information are presented on cask structural design, materials and fabrication, shielding, criticality, and heat transfer. (auth)

45325 IMPROVED PROCESS FOR PRODUCING SOLID COATED PRODUCTS FROM AQUEOUS SLURRIES AND EQUIPMENT FOR CARRYING OUT SAID PROCESS. (to Commissariat a l'Energie Atomique). British Patent 1,086,719. Oct. 11, 1967. Priority date Oct. 17, 1963, France.

A process and equipment used in producing solid products from liquid suspensions such as waste solutions are described. Particles in suspension are coated with fluidified bitumen, separated from the liquid, subjected to an increasing pressure, cooled, and poured to form solid blocks of suitable plasticity. The equipment consists of a device for coating particles in suspension, a separator for the coated particles, and a drying apparatus for gasifying and extracting remaining liquids. (F.S.)

45326 GUIDE FOR DESIGN AND OPERATION OF SHIPPING CONTAINERS FOR IRRADIATED SOLID FUEL FROM NUCLEAR REACTORS. American Standards Association N5.3(1964). New York, American Institute of Chemical Engineers, 1965. 12p.

The design and operation of containers for off-plant shipment of irradiated solid fuel including ^{233}U, ^{235}U, ^{239}Pu, and ^{241}Pu, either by land or water vehicles, to provide a high and consistent degree of protection to the public are discussed. The standard does not apply to shipments within an establishment where the general public is not in the proximity of the shipment, or to shipment exclusively by water or to air transportation or to fuel with a radiation level of less than 1 R/hr at all surfaces of the fuel element. The standard deals only with the cask and its contents. Method of mounting the casks on vehicles, operation of vehicles, control, and methods of reporting are not included. (F.S.)

Vacuum Engineering

45327 (LA-DC-8978) IMPROVED TEE CONNECTIONS FOR VACUUM SYSTEMS. Ruess, Hermann M. (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-36. 13p. (CONF-680401-1). Dep. CFSTI.

From 4th General Meeting on International Organization for Vacuum Science and Technology, Manchester, England.

Improved welded tee connections are made by drawing a die of circular cross section through an elliptical cutout in the wall of the main tube to form a smooth tee transition. The shape of the cutout is such that the end of the tee is a flat surface requiring only minor weld preparation. The end of the tee is then butt welded by a full penetration fusion weld to the extension tube. This weld is simpler and more reliable then those required by other methods, sharp edges at the tee are eliminated, and the appearance and performance of the vacuum system are improved. Tooling required for the process is simple and inexpensive, and the process is easily adapted to single-system fabrication, mass production, or field application. (auth)

45328 REFERENCE-TRANSFER METHOD OF VACUUM-GAGE CALIBRATION. Morrison, Charles F. (Granville-Phillips Co., Boulder, Colo.). J. Vac. Sci. Technol., 4: 246-51(Sept.-Oct. 1967).

A new vacuum-gauge calibration method is described. The pressure ratio generated by the molecular flow of gas through two known, fixed, series conductances is applied repeatedly, serially in time, to establish a progression of increasing chamber pressures. A single pressure indication serves as the higher value in one ratio and the lower value in the succeeding ratio, thereby correlating the calibration pressures by a fixed known factor. Calibration pressures can be calculated after one of them is sufficiently high to be measured accurately by a reference system. In one modification, gauges are calibrated on a symmetrical, well-baffled chamber connected directly to the pump by a large conductance, thus significantly reducing the possible interaction between the establishment of new calibration pressures, and the pumping or outgassing of gauges being calibrated. A simple, single-pump apparatus suffices for calibrating from 10^{-3} torr to within a decade of the system ultimate pressure. Reproducibility in the order of 2% is achieved in the 10^{-9} torr decade. (auth)

45329 PRESSURE EQUATIONS FOR THE RESIDUAL GASES IN AN ULTRAHIGH VACUUM SYSTEM. Hobson, J. P.; Earnshaw, J. W. (National Research Council, Ottawa). J. Vac. Sci. Technol., 4: 257-73(Sept.-Oct. 1967).

The conventional first-order linear differential equation for the partial pressures of the residual gases in an ultrahigh vacuum system has been tested experimentally and found to be satisfactory for He, CH_4, N_2, and Ar but unsatisfactory for H_2 and CO. Two simultaneous first-order linear differential equations, based upon a model postulating a surface phase obeying Henry's Law, are

suggested for H_2 and CO. The solutions to these simultaneous equations yield greatly improved but not complete agreement with experiment. Qualitative suggestions are made for further improvement of the model. Literature concerning quantitative measurements of H_2 and CO in ultrahigh vacuum systems and based upon the conventional pressure equation is re-examined critically in terms of the new system of equations. (auth)

45330 THERMAL RE-EMISSION OF INERT GAS ATOMS IN TUNGSTEN AND GOLD. Erents, K.; Layson, R. P. W.; Carter, G. (Univ. of Liverpool). J. Vac. Sci. Technol., 4: 252-6(Sept.-Oct. 1967).

Inert gas ions of energies between 100 eV and 2 keV have been injected into polycrystalline tungsten and gold. The subsequent thermal desorption of entrapped ions from these targets has distinct peak structures, and an attempt has been made to correlate the energies associated with these peaks in the desorption spectrum with normal defect-migration processes in the target materials. (auth)

45331 PRESSURE CONVERSION CONSTANTS FOR MAGNETRON IONIZATION GAGES. Pelz, David; Newton, George. (Goddard Space Flight Center, Greenbelt, Maryland). J. Vac. Sci. Technol., 4: 239-45(Sept.-Oct. 1967).

The gas calibrations of the Explorer 32 satellite atmospheric density experiment provided comparisons of the operation of the following five kinds of ionization gauges: flight type, glass enveloped, cold cathode, magnetron gauge (model NRC-528), flight type, metal enveloped, cold cathode, magnetron gauge (model GCA-R5), commercially available, glass enveloped, Redhead gauge (model NRC-552), flight type, metal enveloped, warm cathode, magnetron gauge (WCM), and commercially available, metal enveloped, Penning-type gauge (model GE-22GT210). The nitrogen pressure responses of these gauges are compared in terms of the conversion constant (C). C is the ratio of the cathode current to the pressure and is related to the number of ions produced per neutral particle in the gauge. The 552 and R5 gauges exhibit values of C which are maximum between 10^{-10} and 10^{-9} torr and decrease at higher pressures. In contrast to this behavior the 528 and 22GT210 gauges exhibit primarily increasing C values with pressure, and the C values of the warm cathode magnetron are constant at low pressures. Experimental results which can be interpreted in terms of the behavior of the negative space charge in the gauges are briefly discussed. A high sensitivity of the R5 gauge response characteristics to anode voltage is demonstrated in terms of C values, oscillation regions, and discontinuities. (auth)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 45192, 45610, 46456, 46500, 46643, and 46937.

45332 (AD–629709) USE OF MOS TRANSISTORS IN SOLID-STATE RADIATION SURVEY METERS. Brayden, Richard; Bowman, Dennis; McSherry, Luke (Army Electronics Command, Fort Monmouth, N. J. Electronic Components Lab.). Feb. 1966. 13p. (ECOM–2661). CFSTI.

An all solid-state survey meter using an MOS transistor instead of an electrometer tube was designed and constructed. The survey meter using one high-megohm resistor had two scale ranges: 500 mr/hr and 50 mr/hr. Additional scale ranges could be obtained using additional high-megohm resistors. As a result of the work it is apparent that an all solid-state survey meter offers distinct advantages over present-day tube models. Low cost, reliability, and compactness are a few of the major features. In addition, it is seen that it will be possible to integrate the entire circuit on a single chip and encase it in a single header for additional size decrease. (auth) (TAB)

45333 (AD–634621) GAMMA-INDUCED SENSITIVITY LOSS IN THE PROPORTIONAL COUNTERS OF A NUCLEAR POWER PLANT. McNally, James K. (Army Engineer Reactors Group, Fort Belvoir, Va.). June 1966. 15p. CFSTI.

Sensitivity of both the ^{10}B-lined and BF_3-filled proportional counters depends strongly upon the gamma flux intensity in which the detector is operating. Loss of sensitivity occurs because of a reduction in pulse height as gamma flux increases. Pulses produced by neutrons and by gamma rays are both reduced in height; therefore, a low discriminator bias may be used to minimize sensitivity loss without counting gamma pulses. Magnitude of the sensitivity loss was approximately the same for ^{10}B lined and BF_3 filled detector types. Characteristics of the voltage plateau change dramatically with a change in gamma flux. Upper and lower ends of the voltage plateau shift to higher voltages as the gamma flux is increased. (auth) (TAB)

45334 (AECL–2766) HEALTH PHYSICS APPLICATIONS OF A THIN SILICON DETECTOR. Yablonovitch, Eli (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Aug. 1967. 11p. Dep. CFSTI. CAN $0.50.

A totally depleted, silicon, dE/dx counter (200 microns thick) was tested for use in general purpose dosimetry. The response to α, β, and γ rays as well as to fast neutrons is presented and the measurements indicate a detector of unusual versatility. (auth)

45335 (BMwF-FBK–67-72) HERSTELLUNG UND EIGENSCHAFTEN VON Si(Li)-DETEKTOREN. (Fabrication and Properties of Si(Li)-Detectors). Maier, G.; Zausig, B. (Hamburg Univ. (West Germany). I. Institut fuer Experimentalphysik). Aug. 1967. 28p. (In German). Dep.

Investigations were performed on the fabrication methods for Si (Li) detectors and their correlated properties. The resulting technique is presented. Some special tests and results for several properties are described and examples of applications are given. (auth)

45336 (BNL–11783) FIELD-EFFECT TRANSISTOR NOISE AS A FUNCTION OF TEMPERATURE AND FREQUENCY. Radeka, V. (Brookhaven National Lab., Upton, N. Y.). [nd]. 16p. (CONF-670520–11). Dep. CFSTI.

From Conference on Semiconductor Nuclear Particle Detectors and Circuits, Gatlinburg, Tenn.

Characteristic features of the temperature- and frequency-dependence of the noise spectrum of field-effect transistors are reported. Data for both silicon- and germanium-junction field-effect transistors are presented. (W.H.K.)

45337 (BNWL–481-4) PACIFIC NORTHWEST LABORATORY ANNUAL REPORT FOR 1966 TO THE USAEC DIVISION OF BIOLOGY AND MEDICINE. VOLUME II. PHYSICAL SCIENCES. PART 4. INSTRUMENTATION. Pearce, D. W.; Compton, M. R. (eds.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 1967. Contract AT(45-1)-1830. 51p. Dep. CFSTI.

Separate abstracts for the 14 papers included in this report are presented. (W.H.K.)

For abstracts of individual sections see: 45338–45344, 45433–45435, 45450–45452, and 46611.

45338 (BNWL–481-4, pp 12-16) LIVE-TIME AND HALF-LIFE CONTROL OF SCANNER FOR WHOLE BODY RADIATION COUNTER. Sheen, E. M.; Palmer, H. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Modifications for scintillation whole-body scanners are presented to correct errors due to analyzer dead time and radionuclide decay during the scan. Live-time control is accomplished by operating the scanner with a stepping motor and reducing the input frequency directly with multichannel analyzer dead time. The frequency is reduced exponentially resulting in scanner velocity decay that follows the radionuclide decay to give a constant calibration. (W.H.K.)

45339 (BNWL–481-4, pp 23-5) WOUND COUNTING WITH SOLID STATE DETECTORS. Swinth, K. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A developed solid state detector system, now being fabricated, will allow accurate measurement of the depth at which a plutonium particle is located in tissue. The system will determine the transmitted intensities of the three L x rays of plutonium and their distinct tissue absorption coefficients to permit measurement of the thickness of the interposed tissue. (auth)

45340 (BNWL–481-4, pp 25-7) COUNTING OF PLUTONIUM IN THE LUNG. Larson, H. V.; Bramson, P. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

An approach to evaluating the quantity of plutonium deposition in the human lung is briefly presented. A comparison of several radiation detectors is proposed to determine which is most suitable for routine use. (W.H.K.)

45341 (BNWL–481-4, pp 39-40) PROGRESS ON THE DEVELOPMENT OF ELECTRONICS FOR SOLID STATE DIODE DETECTORS. Philipp, L. D. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Development of lithium-drifted silicon and germanium detectors for gamma-ray spectroscopy is reported. Modifications to improve the detection efficiency of this system to low-energy photons are discussed. (W.H.K.)

45342 (BNWL–481-4, pp 40-2) SURFACE CONTOURED DIODE INVESTIGATIONS. Swinth, K. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A small detector unit utilizing a contoured diode and obtained through the AEC Division of Biology and Medicine was investigated for its radiation measuring characteristics. The highest intrinsic efficiency ($4.8 \pm 0.5\%$) was obtained for plutonium L X rays. Lower efficiencies resulted at both higher and lower energies. (auth)

45343 (BNWL–481-4, pp 42-5) PROGRESS IN X-RAY–ALPHA STUDIES WITH SOLID STATE DETECTORS. Swinth, K. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Progress on a counting system to determine the x rays per unit dose and the isotopic composition of plutonium samples is described. A system that will use solid-state detectors to count the photons and alpha particles from a plutonium source is planned. By coincidence technique, the isotopic composition may be determined. (W.H.K.)

45344 (BNWL–481-4, pp 46) NEUTRON SENSITIVE CRITICALITY ALARM SYSTEM. Rising, F. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A neutron sensitive, but gamma insensitive, criticality alarm system is briefly described. The detector is an undermoderated boron-trifluoride tube which is sensitive to a wide spectrum of neutron energies. The system can be set to alarm at 20 mrem/hr or less of neutrons. (W.H.K.)

45345 (IDO–17234) INSTRUMENT DEVELOPMENT BRANCH ANNUAL REPORT, 1966. Wilde, N.; Boland, T. J.; Anderson, S. D. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). July 1967. Contract AT(10-1)-205. 99p. Dep. CFSTI.

The activities of the Instrument Development Branch for the year ending 1966 are reported in three sections: specialized detector and transducer development, instrument components and systems development, and instrumentation analysis. (B.G.D.)

45346 (INR–785/XIX/D) POSSIBILITIES OF USING ORGANIC SCINTILLATION DETECTORS IN MEASUREMENTS OF DOSE EQUIVALENT AND QUALITY FACTOR IN MIXED NEUTRON-GAMMA RADIATION. Pszona, S. (Institute of Nuclear Research, Warsaw (Poland)). 1967. 9p. Dep.

The response of organic scintillation detectors in the mixed neutron–gamma radiation was analyzed. It was proved, that it is possible to use the new detectors system to measure dose equivalent and quality factor of mixed neutron–gamma radiation.

The system consist with a tissue equivalent chamber and an organic scintillator. Some preliminary results were quoted. (auth)

45347 (INR-799/XIX/NT) METHOD OF ABSOLUTE GAMMA SOURCES ACTIVITY MEASUREMENT USING A SCINTILLATION COUNTER IN FIXED GEOMETRY. Zarnowiecki, K. (Institute of Nuclear Research, Warsaw (Poland)). 1967. 13p. Dep.

It was calculated that the efficiency of a gamma scintillation counter is lower than one obtained from a simple exponential formula. The influence of escape of the fluorescence x-rays and anihilation photons and the presence of low energy Compton electrons was taken into account. It was proved that a counter in collimated geometry can be used for the absolute measurements of gamma source activity. The method of calculating of the correction factors for filters and a collimator permeability are given. The experimental results agree very well with the theoretical calculations. (auth)

45348 (JINR-P13-3340) MAGNITNYI AL'FA-SPEKTROGRAF S DVOINOI FOKUSIROVKOI. (Double Focusing Magnetic α Spectrometer). Golovkov, N. A.; Gromov, K. Ya.; Denisov, Yu. N.; (and others) (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1967. 28p. (In Russian). Dep.

A double-focusing magnetic α spectrometer was designed and constructed. The α spectrometer is described and its installation for measurement of magnetic fields is reported. The shape of the magnetic fields of the spectrometer is determined and its focusing properties are measured. The methods used for the calibration of the spectrograph are discussed. (J.S.R.)

45349 (LYCEN-6738) LES METHODES D'IDENTIFICATION DES PARTICULES EN INSTRUMENTATION NUCLEAIRE, LYON, 19-20-21 JANVIER 1967. (Methods of Identification of Particles in Nuclear Instrumentation, Lyon, January 19-21, 1967). (Lyon Univ. (France). Institut de Physique Nucleaire). 1967. 208p. (In French). (CONF-670118-). Dep.

From Conference on Identification of Particles in Nuclear Instrumentation, Lyon, France.

Separate abstracts were prepared for each of the eighteen papers presented. (B.G.D.)

For abstracts of individual papers see: 45350-45366 and 45455.

45350 (LYCEN-6738, pp 1-24) L'IDENTIFICATION DES PARTICULES. (Particle Identification). Feuvrais, L. (Lyon Univ. (France). Institut de Physique Nucleaire). (In French).

For each particle there are parameters which characterize it and therefore permit its identification. There are experimental devices which permit these parameters to be extracted. The different parameters that can characterize a particle are reviewed and the devices that can be used to extract these parameters are described. The devices that give the best results in particle identification are described. These divided into devices based on the detection of particles in the focal plane of a magnet, the use of an E-dE/dx telescope, and identification methods using only a single detector. (J.S.R.)

45351 (LYCEN-6738, pp 25-7) PROBLEMES PHYSIQUES DANS L'IDENTIFICATION DES PARTICULES CHARGEES PAR LA RELATION PARCOURS-ENERGIE. (Physical Problems in Identification of Charged Particles by the Range-Energy Relation). Detraz, C. (Paris Univ., Orsay (France). Laboratoire Joliot-Curie de Physique Nucleaire). (In French).

If an analytical relation $R = af(E)$ between the path and energy of a particle in a given absorbent where f is independent of the nature of the particle, the measurement of the energy E_1 and E_2 of the particle before and after crossing the absorber permits a definition of an identification parameter I independent of the energy of the particle. The physical causes of a dispersion of the values of I are outlined. The straggling effect in the ΔE counter seems to be the most severe problem. (J.S.R.)

45352 (LYCEN-6738, pp 28-33) SYSTEME D'IDENTIFICATION DE PARTICULES UTILISANT DEUX JONCTIONS "PERTE D'ENERGIE." (System for Identification of Particles Utilizing Two "Loss-of-Energy" Junctions). Bruge, G.; Chaminade, R.; Faivre, J. C.; Pain, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires); Bussiere, A.; Roussel, P. (Paris Univ., Orsay (France). Laboratoire Joliot-Curie de Physique Nucleaire). (In French).

A particle identification system based on the range-energy relation $R \cong E^{1.73}$ in which the fraction of erroneous identification due to dispersion in the ΔE detector was decreased by the use of two independent identifications with the aid of a telescope containing two ΔE detectors and one E detector. The identification circuits and the switch off circuits used in this system are given and their operational characteristics are reported. Typical spectra to illustrate the efficiency of the system are given. (J.S.R.)

45353 (LYCEN-6738, pp 34-9) IDENTIFICATION DE PROTONS, DEUTONS, TRITONS, HELIUM-3 ET ALPHA DE 2A 130 MeV D'APRES LES COURBES ΔE $\Delta x = f(E)$. (Identification of 130-MeV Protons, Deuterons, Tritons, ^{3}He, and alpha Particles According to $\Delta E/\Delta x = f(E)$ Curves). Du Bost, H.; Gatty, B.; Lefort, M.; Tarrago, X. (Paris Univ., Orsay (France). Faculte des Sciences). (In French).

A telescope system with Si semiconductor detectors that can be used to measure simultaneously the energy of particles and the energy loss that particles undergo in a thin detector was used for the detection of protons, deuterons, tritons, ^{3}He, and α particles. The telescope system and its behavior are described in detail. The linear and logical chain of the electronics associated with the detectors are included. The results obtained with this system and their examination are briefly discussed. (J.S.R.)

45354 (LYCEN-6738, pp 40-1) ANALYSE DE PARTICULES A L'AIDE D'UNE JONCTION A LOCALISATION DANS DE PLAN IMAGE D'UN AIMANT. (Analysis of Particles by Means of a Junction Detector in the Image Plane of a Magnet). Rotbard; Kalifa; Ronsin; Vergnes (Paris Univ., Orsay (France). Laboratoire Joliot-Curie de Physique Nucleaire). (In French).

The use of a position-sensitive detector in the image plane of a magnet for particle detection was studied using the reaction $^{32}S(^3He,\alpha)^{31}S$. An example of the energy spectrum obtained is given. The results show that a position-sensitive detector is well adapted to being used with a magnetic analyzer having a focal plane of short lengths. If the focal plane is longer, there is a possibility of using several of these detectors end to end. (J.S.R.)

45355 (LYCEN-6738, pp 66-79) UTILISATION D'UN CALCULATEUR DANS UNE EXPERIENCE DE DETECTION SIMULTANEE DES PARTICULES d, t, ^{3}He ET α AVEC UN TELESCOPE A TROIS DETECTEURS. (Use of a Computer in an Experiment of Simultaneous Detection of d, t, ^{3}He, and α Particles With a Telescope Having Three Detectors). Bouche, R.; Feuvrais, L.; Gaillard, M.; Gaillard, P.; Gouvanere, M.; Guichard, A.; Gusakow, M.; Leonhardt, J. L.; Pizzi, J. R.; Vidal, J. L. (Lyon Univ. (France). Institut de Physique Nucleaire). (In French).

In an experiment on the simultaneous detection of d, t, ^{3}He, and α particles with a three-detector telescope a computer was used for the data processing. The three series of energy data are recorded on perforated tapes. The identification takes place at a different time under a numerical form using a CAE 510 calculator. The data acquisition system is described with emphasis on the advantages and disadvantages of the devices and procedures used. The majority of the inconveniences were suppressed by the use of a computer connected directly to the experiment. The acquisition chain that made possible the utilization of a CAE 90.10 computer working in real time is described in detail. The acquisition chains with processing in different time and real time are described. (J.S.R.)

45356 (LYCEN-6738, pp 80-92) INFLUENCE DU BRUIT DE FOND DANS UNE EXPERIENCE D'IDENTIFICATION DE PARTICULES. POSSIBILITES ACTUELLES D'AMELIORATION DU RAPPORT SIGNAL/BRUIT DANS LES EXPERIENCES D'IDENTIFICATION DE PARTICULES PAR TRAITEMENT DU SIGNAL. (Influence of Background Noise in an Experiment on Identification of Particles. Present Possibilities of Improving Signal/Noise Ratio in Experiments of Particle Identification by Signal Processing). Escudie, B. (Lyon Univ. (France). Institut de Physique Nucleaire). (In French).

In particle detection using the ionization procedure or $\Delta E/\Delta x$ there are problems connected with the detection of the signal and with its extraction from the background noise in order to improve the signal/noise ratio of the identification functions. It is shown how these two problems can be resolved by processing the signal. Some properties of the noise or random functions are first reviewed. The analysis of the signal processing method shows that this method makes it possible to detect the presence of the ΔE signal in the noise and to release the identification operation in its presence alone and simultaneously with that of the E signal. The signal/noise ratio can therefore be improved and therefore the final precision on the identification function either by optimum filtering or by correlation. (J.S.R.)

45357 (LYCEN-6738, pp 93-107) DEPOUILLEMENT AUTOMATIQUE D'INFORMATIONS PROVENANT DE CHAMBRES A ETINCELLES A MAGNETOSTRICTION. (Automatic Analysis of Information From Magnetostrictive Spark Chambers). Rabany, M.; Tocqueville, J.; Bruere-Dawson, M.; Marqueste, Ph.; Turlot, J. P. (College de France, Paris. Laboratoire de Physique Atomique et Moleculaire). (In French).

The processing of data from magnetostrictive spark chamber measurement of elastic differential cross sections was carried out by an on-line computer. The design and construction of the spark chamber is briefly described. The principle of the on-line

computer is outlined. The principal circuits of the computer are given and discussed. (J.S.R.)

45358 (LYCEN–6738, pp 108-14) PROJET D'UTILISATION D'UN CALCULATEUR C,90,10 DANS UNE EXPERIENCE DE LEPTO-PRODUCTION EN COINCIDENCE. (Utilization of a C,90,10 Computer in an Experiment on Lepton Production in Coincidence). Schulmann, D.; Dumas, J. C. (College de France, Paris. Laboratoire de Physique Atomique et Moleculaire). (In French).

The experimental apparatus for coincidence measurements of lepton production was described. The characteristics and functions of the four scintillation detectors used are given. The logical scheme for processing of the data before input into the on-line computer is described. The program of the on-line computer for data processing is outlined. (J.S.R.)

45359 (LYCEN–6738, pp 115-23) ETUDE THEORIQUE DE LA METHODE E dE/dx D'IDENTIFICATION DES PARTICULES. (Theoretical Study of the E dE/dx Method of Identification of Particles). Renaud, J.; Depraz, J. (Lyon Univ. (France). Institut de Physique Nucleaire). (In French).

A theoretical study was made of the E dE/dx method for the identification of particles with Si detectors. The energy losses in the ΔE detector were calculated for various energies of the incidence particles and for different thicknesses. The fluctuations of ΔE by the convolution products were studied. The theoretical probability of $E^{0.0}\Delta E$ and $E^{1.75} - (E - \Delta E)^{1.75}$ were studied by ^{3}He and ^{4}He. The agreement between theoretical and experimental curves was satisfactory. (J.S.R.)

45360 (LYCEN–6738, pp 124-49) METHODES D'IDENTIFICATION DE PARTICULES A BASSE ENERGIE ($E \leq 15$ MeV). (Methods of Identification of Particles of Low Energy ($E \leq 15$ MeV)). Walter, G. (Strasbourg Univ. (France). Institut de Recherches Nucleaires). (In French).

The principles, techniques, and most important results obtained in the identification of low energy particles ($E \leq 15$ MeV) using the simultaneous measurement for each particle detected of the energy loss ΔE in a thin counter and of its energy E, the measurement of the time of flight, and the form discrimination made on the signal delivered by the semiconductor or scintillator detector are given. The advantages that each method offer are indicated. 64 references. (J.S.R.)

45361 (LYCEN–6738, pp 150-4) IDENTIFICATION DES IONS LOURDS PAR ANALYSE MAGNETIQUE ET MESURE D'ENERGIE. (Identification of Heavy Ions by Magnetic Analysis and Measurement of Energy). Liu, M.; Mazloum, F.; Bimbot, L.; Jacmart, J. C.; Riou, M. (Paris Univ., Orsay (France). Laboratoire Joliot-Curie de Physique Nucleaire). (In French).

Preliminary experiments made to determine the efficiency of the particle identification method by magnetic analysis and measurement of energy losses in a moderator were reported. The preliminary experiments were made with the ^{14}N beam. The identification spectra obtained with and without a moderator placed four microns in front of a junction detector were given. These preliminary results showed the advantages of the method and lead to the conclusion that this method is a very useful tool when the number of reaction products is high and when a very precise study is necessary. (J.S.R.)

45362 (LYCEN–6738, pp 155-75) UTILISATION D'UN DISCRIMINATEUR NEUTRON–GAMMA DANS LA DETECTION DES NEUTRONS RAPIDES. (Utilization of a Neutron–Gamma Discriminator in Detection of Fast Neutrons). Cassagnou, Y. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). (In French).

The possibilities and the limitations of a neutron-γ discriminator in the detection of fast neutrons are illustrated by studies of (n,n'), (p,n), and (d,n) reactions made during the last year at the Oak Ridge National Laboratory. The principle of the neutron$-\gamma$ discrimination is outlined. Results obtained on the $^{55}Mn(p,n)^{55}Fe$, $^{65}Cu(p,n)^{65}Zn$ and $^{51}V(p,n)^{51}Cr$ reactions are reported. Preliminary results obtained on the reactions $^{58}Ni(d,n)^{59}Cu$ and $^{60}Ni(d,n)^{61}Cu$ are also reported. (J.S.R.)

45363 (LYCEN–6738, pp 176-9) UN CIRCUIT DE DISCRIMINATION γ-n. (A γ-n Discrimination Circuit). Henchoz, A.; Joseph, C. (Lausanne Univ. (Switzerland). Institut de Physique Nucleaire). (In French).

A γ-n discrimination using a NE 213 scintillator was described. Tests on the γ efficiencies and n efficiencies are reported. (J.S.R.)

45364 (LYCEN–6738, pp 180-90) REALISATION D'UN DISPOSITIF DE DISCRIMINATION NEUTRON–GAMMA. APPLICATION A L'ETUDE DE LA REACTION $^{7}Li + d \rightarrow 2\alpha + n$. (Development of a Neutron–Gamma Discrimination Apparatus. Application to Study of the Reaction $^{7}Li + d \rightarrow 2\alpha + n$). Flamant, Y. (Institut d'Etudes Nucleaire, Algiers (Algeria)). (In French).

A device for the discrimination of neutron and γ radiation was developed. The output circuits of the photomultiplier and the circuits effecting the neutron-γ discrimination are given and the control of the discrimination was tested with low energy and high energy neutrons. The device was then applied to the $^{7}Li + d \rightarrow 2\alpha + n$ reaction at 2 MeV. The results are graphed and show that for the directions 80, 85, and 90° of the α detector the maximum of the α spectrum in coincidence is much higher than that of the free α spectrum. (J.S.R.)

45365 (LYCEN–6738, pp 191-200) ENSEMBLE MULTIDIMENSIONNEL DESTINE A L'ETUDE DES REACTIONS DU TYPE A(x,nγ)B. (Multidimensional Ensemble Applied to Study of Reactions of the A(x,nγ)B Type). Avignon, P.; Deschamps, Y.; Goby, G.; Rosenbaum, B.; Rosier, L. (Paris Univ., Orsay (France). Laboratoire Joliot-Curie de Physique Nucleaire). (In French).

A multidimensional apparatus was developed for the study of reactions of the A(x,nγ)B type. The apparatus performs the following functions: obtention of data, organization of data, and data processing. In data obtention there is neutron-γ discrimination in the neutron detectors, analysis of the neutron energies by time-of-flight, and analysis of γ energy. The function and operation of each constituent of the apparatus for data obtention, organization and processing are described. (J.S.R.)

45366 (LYCEN–6738, pp 201-4) TELESCOPE A SEMICONDUCTEURS POUR L'ETUDE SIMULTANEE DES REACTIONS (n,p), (n,d) ET (n,t) A 14 MeV. (Telescope With Semiconductors for Simultaneous Study of (n,p), (n,d), and (n,t) Reactions at 14 MeV). Merchez, F.; Helleboid, J. M.; Pouxe, J.; Perrin, G.; Benedetti, G. (Grenoble Univ. (France). Laboratoire de Physique Nucleaire, Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaire). (In French).

The semiconductor telescope for the study of (n, charged particle) reaction on light nuclei is described. The electronic apparatus for the two detectors, device for the measurement of the time-of-flight, and the three-detector telescope are shown schematically. The data processing made on an IBM 7044 follows a program outline. (J.S.R.)

45367 (MLM–1373) DETECTION OF PLUTONIUM OXIDE IN TRASH DRUMS BY NEUTRON COUNTING. Wylie, K. F. (Mound Lab., Miamisburg, Ohio). July 1, 1966. Contract AT(33-1)-Gen-53. 13p. Dep. CFSTI.

Neutron counting with gamma-radiation-insensitive proportional detectors was investigated as a potential survey method for detecting recoverable plutonium-238 (in the form of an oxide) contained in a 55-gal trash drum. Initial studies indicated that a counting procedure for the trash drums could be established which would permit determination of quantities of plutonium-238 equal to or greater than an arbitrary value of 0.165 g with an experimental accuracy of ±17%. Although the actual trash possessed a negligible amount of neutron-absorbing materials, it did contain such items as air filters and ion exchange resins which acted to increase the neutron count rate due to (α,n) reactions on light nuclei. The presence of these materials in any given trash drum makes it impossible to relate the neutron count rate to a given amount of plutonium-238. It was possible to establish a go–no go type of analysis based on an established minimum allowable quantity of plutonium-238, provided the minimum is greater than about 150 mg. (auth)

45368 (N–67-25871) PHOTOMULTIPLIER TUBE AMPLIFIER–DISCRIMINATOR. Final Report. (Analog Technology Corp., Pasadena, Calif.). Jan. 13, 1967. Contract NAS7-100. 249p. (NASA-CR–83881). CFSTI.

For Jet Propulsion Lab., Pasadena, Calif.

The design, construction, and testing of a photomultiplier tube amplifier-discriminator system are discussed. The amplifier receives signals from photomultiplier tubes looking at NaI crystals and converts them into pulses suitable for pulse-height analysis. Appropriate gain and pulse shaping are provided by the amplifier for the observation of gamma rays with energies in the 100 keV to 10 MeV range. A discriminator connected to the amplifier output provides a pulse when the amplifier output signal exceeds 1% of full scale (10V). In this way an accurate determination of counting rates above this threshold can be made independently of analyzer dead time. Also coincidence gating and other such logic functions can be performed using this pulse. (STAR)

45369 (NP–16896) LA DESCARGA GEIGER Y NUEVAS APLICACIONES DEL DETECTOR GEIGER–MUELLER. (Geiger Discharge and New Applications of a Geiger–Mueller Detector). de Swaan Oliva, Abraham Luis (Universidad Nacional Autonoma

de Mexico, Mexico City. Facultad de Ciencias). 1964. 34p. (In Spanish). Dep.

Thesis.

A study was made of the possibility of using the G-M detector as an indicator of the position of a particle bunch as a function of the form and shape of the bunch, the point of incidence along the detector, and of the ionizing particle. New applications of the G-M detector to the measurement of the penetration of ionizing particles in gaseous mixtures of the filling gas was discussed. An explanation of large pulses is given. (J.S.R.)

45370 (ORAU-101, pp 156-8) IMPROVED PROBE FOR DETECTING RADIOACTIVITY AT SURGERY. Morris, A. C. Jr. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

Design features are described of a surgical probe with CsI detector measuring 0.220 in. in diameter by $\frac{3}{8}$ in. long, mounted in the end of a 0.25 in.-diameter tube. Surrounding the detector crystal is an annular-shaped collimator, made of a high-Z material, that may be applied or removed depending on the requirements of the surgeon. Light induced by β or γ rays in the detector is coupled back through a light pipe to a miniature 0.5 in.-diameter photomultiplier tube and remotely located preamplifier. Both the high-voltage supply to the probe and signals from the probe are carried on one coaxial cable. Performance of the probe for the measurements of activity from ^{241}Am, ^{137}Cs, and ^{131}I in functioning and metastatic tissues is discussed. (C.H.)

45371 (ORNL-4146, pp 78-83) HEALTH PHYSICS INSTRUMENTATION. (Oak Ridge National Lab., Tenn.).

Data and information are presented concerning instrument inventory, calibration facility, and instrumentation developments. (J.R.D.)

45372 (ORNL-TM-1874) DESCRIPTION OF FACILITY RADIATION AND CONTAMINATION ALARM SYSTEMS INSTALLED IN THE BULK SHIELDING FACILITY, BUILDING 3010. Russell, J. A. Jr.; Knowles, D. J. (Oak Ridge National Lab., Tenn.). Aug. 22, 1967. Contract W-7405-eng-26. 23p. Dep. CFSTI.

Facility radiation and contamination alarm systems were installed in the Bulk Shielding Facility, Building 3010, to continuously and automatically monitor gamma radiation (by three gamma monitrons) and air contamination (by three beta-gamma air monitors) in the entire facility. These instruments and other components in the network provide health physics monitoring information, sound local alarms when abnormal conditions occur, and indicate these conditions on central panel boards in the control room and in the ORR control room. The building evacuation and containment systems operate automatically when two or more monitrons or two or more air monitors detect a high level of radiation or air contamination. (auth)

45373 (UCRL-17635) PATTERN RECOGNITION IN BUBBLE CHAMBERS. White, Howard S. (California Univ., Berkeley. Lawrence Radiation Lab.). June 22, 1967. Contract W-7405-eng-48. 28p. (CONF-670627-2). Dep. CFSTI.

From Seminar on Computerized Imaging Techniques, Washington, D. C.

A review of the scanning and measurement systems for analyzing particle tracks from bubble-chamber photographs is presented. Discussed are conventional measurement systems, manually directed—computer assisted systems, manual scanning—automatic measurement systems, and entirely automatic measurement systems. (W.H.K.)

45374 (SLAC-Trans-72) BUBBLE CHAMBER ONE-AND-A-HALF METERS IN DIAMETER WITH A SUPERCONDUCTING MAGNET, FILLED WITH HYDROGEN, DEUTERIUM, OR HELIUM (SUBSTANTIATION AND DRAFT). Belonogov, A. V.; Vetlitskii, I. A.; Guzhavin, V. M.; (and others) (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). Translated for Stanford Linear Accelerator Center, Calif., from report ITEF-496. 58p. Dep. CFSTI. JCL $5.60 fs, $1.94 mf.

The design of a bubble chamber 1.5 meters in diameter and 1.6 cubic meters in volume, with a superconducting magnet creating a 60- to 80-kg field, is examined. Uses of the chamber, accuracy of experimental data obtained from the chamber, the technical feasibility of manufacturing its subassemblies, and an estimate of the cost of building the chamber complex are presented. (W.H.K.)

45375 (UCRL-Trans-10127) PYROELECTRIC PROPERTIES OF SOME SUBSTANCES AND THEIR APPLICATION TO INFRARED DETECTION. Hadni, Armand; Henninger, Yolande; Thomas, Robert; Vergnat, Pierre; Wyncke, Bruno. Translated by Donald T. Hocking for Univ. of California Lawrence Radiation Lab., Livermore, from J. Phys. (Paris), 26: 345-60(1965). 56p. Dep. CFSTI. JCL $5.60 fs, $1.88 mf.

A comprehensive study of the pyroelectric properties of triglycine sulfate and its use for infrared detection is presented. Potassium dihydrogen phosphate and triglycine selenate are also considered. Topics included are temperature variation, pyroelectric capacitor, calculation of the pyroelectric signal, and application to thermal television. (W.H.K.)

45376 ENERGY ABSORPTION SPECTRUM-RADIATION DOSE CONVERSION OPERATOR. II. AUTOMATION OF OPERATION. Moriuchi, Shigeru; Miyanaga, Ichiro (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 9: 518-23(Sept. 1967). (In Japanese).

The generalized operator which is a kind of weighting function to govern the energy absorption distribution function is discussed. In this respect, the methods based on time encoding and binary scaling are expedient for automatic weighting of energy. Both these methods however entail complex electronic circuits except in cases where the operator has the form of a linear function. For automatic operation of the generalized operator, it is shown that automatic discrimination bias modulation possesses the flexibility required for adaption to any form of operator. This method uses ac waves for the discrimination bias, which takes the form of inversed operator-function, so that passage through gate of the input signal from the detector can be determined by its pulse height, and thus permits obtaining an output proportional to the radiation dose of interest. Electronic circuits are shown for possible forms of the operator function. (auth)

45377 ELECTRIC IMPULSES GIVEN BY THE RADIATION DETECTORS WITH SEMICONDUCTOR DEVICES OF CYLINDRICAL FORM. Poenaru, Dorin N. Electrotehnica (Bucharest), 15: 301-6(Aug. 1967). (In Rumanian).

The shape of the current impulse and the electric charge obtained by collecting a single electron-hole pair produced by ionization in the sensitive volume of a coaxial Ge (Li) detector cooled at the temperature of liquid nitrogen was calculated. (auth)

45378 PROFILE OF SPECTRAL LINES FURNISHED BY PAIR SPECTROMETERS WITH A Ge n-i-p DIODE. Huguet, Michel; Forest, Hugues; Ythier, Christian (Faculte des Sciences, Nice). Compt. Rend., Ser. A and B, 264: 1846-9(June 26, 1967). (In French).

The spectral distribution furnished by a pair spectrometer for a monoenergetic γ transition has various structures on both sides of the double escape peak; an interpretation is proposed for one of these structures. (tr-auth)

45379 BACK-SCATTERING OF ELECTRONS FROM SILICON PIN DETECTORS. Huehn, E. A.; Schneider, H. (Justus Liebig Univ., Giessen, Ger.). Kerntechnik, 9: 397-8(Sept. 1967). (In German).

The response of Li-drifted Si detectors to monoenergetic electrons with primary energies from 200 keV to 1.7 MeV was studied. The low-energy tail and the loss factor were determined from the measured spectra. The loss factor, corrected for detector geometry, varied from 17% at 200 keV to 40% at 1.7 MeV as a linear function of the primary electron energy. It was found, that besides the back-scattering another effect contributes to the low-energy tail, possibly caused by the ionization in the Si-wafer of the counter. This effect becomes dominating with increasing electron energy. For that reason we used the general terms loss factor and low-energy tail rather than back-scattering factor and back-scattering tail. The results were applied to correct the Tl 204 Curie plot. (auth)

45380 METHODS FOR QUENCH CORRECTION IN LIQUID SCINTILLATION COUNTING. Ruge, I.; Kaczmarczyk, N. (Technische Hochschule, Munich). Kerntechnik, 9: 399-406(Sept. 1967). (In German).

In order to determine the activity of low-energy beta emitters, the counting efficiency of the sample must be known. A review of methods for efficiency determination is presented. The methods are described and their advantages and disadvantages are compared. (auth)

45381 BETA-COUNTING SENSITIVITIES OF SILICON SURFACE BARRIER DETECTORS. Morley, B. J.; Parker, R. P. (Royal Cancer Hospital, Belmont, Eng.). Phys. Med. Biol., 12: 511-22(Oct. 1967).

A study was made of the β-counting properties of two detectors: a needle probe 3 mm diameter and 2 cm long, and a disc-shaped wafer detector 3 cm diameter and 5 mm thick. These were exposed to thick sources of ^{131}I, ^{24}Na, ^{32}P, and ^{42}K having approximately 4π geometry for the probe and 2π geometry for the wafer. The absorbed energy spectra are depicted, together with the resulting integral count rate as a function of discriminator level, and the dependence of these on the sensitive detector volume is

considered. The maximum practical sensitivity of the probe detector to ^{32}P was 0.9 counts/sec for a solution of specific activity 10^{-9} Ci/ml at 37°C, with a background count rate of 0.3 counts/sec; this compares favorably with Geiger counters and Li-drifted silicon detectors of similar dimensions. (auth)

45382 A COMPLICATING FACTOR IN THE USE OF PLASTIC SCINTILLATORS IN THE DETECTION OF LOW-ENERGY BETA-RAYS: THE SOLUBILITY AND DIFFUSIVITY OF CARBON DIOXIDE IN A SOLUTION OF PHOSPHORS IN POLYVINYLTOLUENE. Bockman, D. D.; Brandt, D. C.; Bobb, A. L. (Univ. of Washington, Seattle). Int. J. Appl. Radiat. Isotop., 18: 728-31(Oct. 1967).

In recent years plastic phosphors have found increasing use in the detection of low-energy beta-rays. A possible deterrent to their use exists, however, in the fact that they absorb and thus are contaminated by the various components of the gases and liquids which are being assayed. Days may be required for the desorption process, even under the most favorable conditions. This absorption phenomenon is discussed. A new method of determining the solubility and diffusivity of a solute in a solid, and hence of determining the permeability of the solid to the solute is described. The solute investigated was carbon dioxide and the solid was NE 102 Plastic Phosphor, a solid solution of scintillators in polyvinyltoluene. All measurements were made at 28°C. (auth)

45383 FUNDAMENTAL APPROACH TO QUENCHING IN LIQUID SCINTILLATORS. Gibson, J. A. B.; Gale, H. J. (Atomic Energy Research Establishment, Harwell, Eng.). Int. J. Appl. Radiat. Isotop., 18: 681-8(Oct. 1967).

A new term relative quenching factor is defined as the fluorescent light output for a quenched solution relative to the light output from an unquenched solution. It is shown experimentally that this factor is independent of beta-ray energy, system gain, and bias voltage and depends only on the liquid scintillator and quencher concentration. This latter dependence can be accurately predicted from simple chemical kinetic theory. The concept of the relative quenching factor is used to provide a universal method of establishing quenching corrections, based on simply measured parameters and linear calibration curves. It allows an objective assessment of methods in current use (e.g. two-channel counting, external source). The practical application of the concept is demonstrated and suggestions for improvements to methods are presented. The relative quenching factor can also be used in the comparison of results between authors using the same scintillator and quenchers, since it is independent of the system used. (auth)

45384 FORMATION OF SPARKS BY SEVERAL ELECTRON AVALANCHES. Frohlich, Alfred (Tel Aviv Univ., Israel). Nature (London), 215: 1362-3(Sept. 23, 1967).

In a spark chamber, interaction between electron avalanches causes the resultant spark to incline along the particle track. At an angle of incidence greater than about 35° the sparks tend to follow the electric field. An extension of theory to include the effects of multiple electron avalanches is described. (auth)

45385 MULTIPLE EMISSION OF ELECTRONS IN A SECONDARY-ELECTRON PARTICLE COUNTER. Collins, L. E.; Stroud, P. T. (Atomic Weapons Research Establishment, Aldermaston, Eng.). Brit. J. Appl. Phys., 18: 1121-5(Aug. 1967).

The statistical distribution of multiple emission of secondary electrons was studied for ^{0}He atoms in the energy range 1 to 5 keV impinging on pure aluminum in a secondary-electron scintillation detector. The results show that the distribution function is Poisson type, and by analysis of only two peaks on the pulse-height spectrum the fraction of incident ^{0}He atoms which fail to cause the emission of an electron can be estimated. Secondary-electron coefficients γ were obtained from the experimental distribution functions for ^{0}He and ^{0}Ar incident on Al. For ^{0}He, γ varied smoothly from 1.3 to 2.4 in the energy range 1 to 5 keV. The effect of argon ion-cleaning of the cathode was also studied. (auth)

45386 PINHOLE IMAGING OF GAMMA RAYS. Paix, D. (Prince Henry Hospital, Little Bay, New South Wales). Phys. Med. Biol., 12: 489-500(Oct. 1967).

An approximate calculation is made of the effective area of pinhole collimators allowing for penetration of the metal by γ-rays of two energies (364 and 140 keV). The particular case of normally incident rays is treated without approximation. At 364 keV the performance even of heavy alloy (90% tungsten) collimators is dominated by penetration. The effective radius may approach twice the nominal value. These calculations are in fair agreement with experimental data. The sensitivity of a thin NaI(Tl) crystal used with such a collimator is approximately proportional to sec ζ, where ζ is the angle of incidence. Allowing for this and the penetration effects, the $\cos^3 \zeta$ law describing the sensitivity becomes modified, for three commercially available pinholes of $1/16$, $3/32$ and $1/8$ in. radius, to $\cos^{5.8} \zeta$, $\cos^{4.6} \zeta$ and $\cos^4 \zeta$ respectively. (auth)

45387 APPLICATION OF PN JUNCTION DIODES TO THE MEASUREMENT OF DOSE DISTRIBUTION OF HIGH ENERGY RADIATION. Trump, Michael A.; Pinkerton, Arthur P. (Sloan-Kettering Inst. for Cancer Research, New York). Phys. Med. Biol., 12: 573-6(Oct. 1967).

A frequently encountered limitation in the use of small ionization chambers for the continuous measurement of dose distributions in a water phantom is the unwanted current generated by cable flexing when the chamber is moved. One method of avoiding these unwanted currents is to use a preamplifier rigidly connected to the chamber. The preamplifier must be sealed and potted to protect it from moisture and to eliminate the effects of stray radiation. Since probe positioning is often accomplished by means of a closed loop servo, the mass of the probe preamplifier combination makes stabilization more difficult. These difficulties can be obviated by replacing the ion chamber with a semiconductor diode, since the current induced in it by a radiation field is approximately 2×10^4 as great as in an ion chamber of equal volume. The use of commercially available pn junction diodes as dosimeters has been favorably reported for x-rays and for very high energy charged particles. The purpose of this study was to evaluate the suitability of a pn junction diode as a radiation probe for an automatic isodosimeter. It is concluded that, if care is taken with regard to conditions, miniature silicon diodes can be used advantageously to measure dose distributions produced by high energy radiations. (auth)

45388 EXPERIMENTAL STUDY OF ION RECOMBINATION IN PARALLEL-PLATE FREE-AIR IONIZATION CHAMBERS. Niatel, M. T. (Institut National de la Sante et de la Recherche Medicale, Paris). Phys. Med. Biol., 12: 555-63(Oct. 1967).

An experimental study of the saturation conditions of parallel-plate free-air ionization chambers is presented. The results may be explained by assuming that two different types of ion recombination (initial and volume recombination) take place simultaneously. Their relative values can be calculated from the results, and are found to agree with theories proposed by Boag, by Scott and Greening, and by Kara–Michailova and Lea. It was found that for the saturation current to be determined by extrapolation the collecting field strength should be high enough for volume recombination to be negligible compared with initial recombination. The extrapolation is of the reciprocal of ionization current against the reciprocal of collecting field strength. (auth)

45389 GENERATOR OF SERIES OF NANOSECOND LIGHT PULSES. Gorbenko, V. G.; Lapshin, V. G.; Rykalin, V. I.; Tsisek, Z.; Khromov, V. P. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 3, 161-4(May-June 1967). (In Russian).

A generator of nanosecond light pulses based on GaP electroluminescent diode is described. The pulse frequencies in the series range from 2 to 100 MHz. The series duration is from 100 nsec to 100 μsec. The duration of the light pulse does not exceed 5 to 7 nsec. The generator is an analog of scintillation and Cherenkov counters and electronic devices used for high-energy particle recording at large pulse loads. (tr-auth)

45390 BETA RECORDING BY THIN LAYER OF SCINTILLATION GRANULES. Gel'fman, A. Ya.; Solomonov, V. M.; Tsirlin, Yu. A.; Ekkerman, V. M. (All-Union Research Inst. of Monocrystals, Kharkov). Prib. Tekh. Eksp., No. 3, 182-4(May-June 1967). (In Russian).

Beta particle detection by thin layers of 0.3 mm granules of polystyrene scintillators was studied. The detection efficiency for ^{35}S and ^{204}Tl as a function of granular layers at various levels of discrimination and differential pulse spectra normalized for various numbers of granules are analyzed. (R.V.J.)

45391 USE OF ELECTRIC CONDUCTING POLYETHYLENE AS SPARK CHAMBER ELECTRODE. Kiselev, Yu. T.; Ushakov, V. I. Prib. Tekh. Eksp., No. 3, 187-9(May-June 1967). (In Russian).

Experiments with a four-gap spark chamber with electrodes constructed from 0.5 mm thick and 250 × 450 mm^2 long conducting polyethylene containing fine-dispersion graphite and polyisobutyl (specific resistance of electrode material ~5 ohm cm^2 with 10 mm interelectrode spacing) showed that such electrodes can be used as targets containing, similarly to the bubble chamber, only carbon and hydrogen. (R.V.J.)

45392 CONTRIBUTION OF SMALL ANGLE NUCLEAR SCATTERING TO ERROR FORMULAE IN BUBBLE CHAMBER ANALYSIS. Johnson, William B. (Stanford Univ., Calif.). Rev. Sci. Instrum., 38: 1602-7(Nov. 1967).

The contribution of small angle nuclear scattering to uncertainties in bubble chamber measurements is reexamined to include experiments at high momenta (above 4 GeV/c). Use is made of recent high energy elastic scattering data to estimate these uncertainties for $\pi^{\pm}$, $K^{\pm}$, p, and $\bar{p}$. Finally the contribution from interference between Coulomb and nuclear scattering is evaluated for $\pi^{\pm}$ and p. (auth)

45393 ENERGY-INDEPENDENT DETECTOR FOR TOTAL HYDROGEN FLUXES IN THE RANGE 1 TO 10 keV FOR SPACE AND LABORATORY APPLICATIONS. Wax, R. L.; Bernstein, W. (TRW Systems, Inc., Redondo Beach, Calif.). Contract NASW-1474. Rev. Sci. Instrum., 38: 1612-15(Nov. 1967).

An energy-independent instrument capable of detecting total hydrogen fluxes (either H^0 or $H^0 + H^+$) in the energy range 1–10 keV was developed. Low extreme ultraviolet sensitivity was achieved by scattering of the incident particles in a thin carbon foil to a detector located in an off-axis position. Energetic electrons are removed by a magnetic field. Measurements of the ratio of the neutral to total fluxes leaving the foil, the angular distribution of the scattered particles, and the energy lost in transit of the foil are presented. The instrument has an efficiency for energetic hydrogen of 0.7%, an euv sensitivity of 2×10^{-3}%, and a geometrical factor of 0.06 cm^2 sr. (auth)

45394 NEW AUTOMATION TECHNIQUE FOR CONSTANT VELOCITY MOESSBAUER SPECTROMETERS. Knauer, Robert C.; Mullen, James B. (Purdue Univ., Lafayette, Ind.). Contract 2671-62-396. Rev. Sci. Instrum., 38: 1624-8(Nov. 1967).

A new technique for automating a Möessbauer mechanical spectrometer is described, which permits arbitrary velocity increments to be programmed on a tape prior to data collection. This novel feature permits optimum efficiency in accumulating data and allows considerable flexibility in measuring particular lines in a Mössbauer spectrum. The system is completely automated and does not require the use of a multichannel analyzer. The velocity stability and uniformity of the complete automated system described was better than 0.1%, and the measured line width for ^{57}Fe in a thin absorber was only 10% greater than the theoretical limit. (auth)

45395 FABRICATION OF LOW COST CAVITY ION CHAMBER. Higgins, Graham S.; Wallace, Charles R. (Sacramento Army Depot, Calif.). Rev. Sci. Instrum., 38: 1671-2(Nov. 1967).

A procedure for fabricating a low-cost cavity ionization chamber is presented. The walls are made of polyester resin and powdered graphite. (W.H.K.)

45396 DIRECTIONAL WIDE-RANGE NEUTRON COUNTER. Goryachev, I. V.; Gvozdev, M. M.; Kukhtevich, V. I.; Trykov, L. A. Prib. Tekh. Eksp., No. 3, 56-8(May-June 1967). (In Russian).

Descriptions are given of the design and performance of directional detector with neutron sensitivity from 5 eV to 5 MeV. Data are given on the measurements of collimator form and neutron scattering from the collimator head. The detector was designed with high-precision directional ordering and was employed for recording differential characteristics of shielding. Descriptions are given of the combined rise of the detector with a single-crystal neutron spectrometer for evaluating the flux below spectroscopic threshold. (tr-auth)

45397 INTRINSIC NOISES OF CORONA COUNTERS. Tolchenov, Yu. M. Prib. Tekh. Eksp., No. 3, 52-5(May-June 1967). (In Russian).

The mechanism of the development and shape of noises from ionizing particle corona counters is described. A simple method is employed for determining optimum sensitivity threshold of the recording scheme operating with corona counter. The dependence of the noise level on the corona counter construction and design parameters and on the counter operation conditions is discussed. (tr-auth)

45398 SYMMETRIC SYSTEM OF SPARK CHAMBER WITH DOUBLE WIRE ELECTRODES. Gus'kov, B. N.; Matyushin, A. T.; Matyushin, V. T.; Firkovskii, R. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 3, 47-50(May-June 1967). (In Russian).

It is shown that a spark chamber using wire electrodes with small (1 cm) and large (15 cm) gaps exhibited a higher recording efficiency and a more uniform luminosity. (tr-auth)

45399 CHARACTERISTICS OF HIGH-PRESSURE SPARK CHAMBER. Akopyan, G. S.; Bostandzhyan, N. Kh.; Marikyan, G. A.; Matevosyan, K. A. (Erevan Inst. of Physics). Prib. Tekh. Eksp., No. 3, 45-7(May-June 1967). (In Russian).

Descriptions are given of the design and performance of a neon-filled spark chamber with small interelectrode gaps and gas pressure of 1 to 6 atm used for determining inclined particle trajectories. It is shown that the distance between the spark tracks and particle trajectories increased with the gas pressure. The track formation efficiency as a function of gas pressure in the chamber and delay time in the high-voltage pulse supply was determined. (R.V.J.)

45400 GAS TARGET FOR EXPERIMENTS WITH SLOW MESONS. Ermolov, P. F.; Lepilov, V. I.; Mukhin, A. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 3, 41-3(May-June 1967). (In Russian).

Descriptions are given of a gas target used for recording slow mesons at gas pressures of 100 atm. Two scintillation counters placed inside the gas achieves effective recording of stopped mesons. At a hydrogen pressure of 50 atm. The device is capable of recording 70% of the total number of stopped mesons. (tr-auth)

45401 GENERATORS FOR STREAMER CHAMBERS. Golutvin, I. A.; Zanevskii, Yu. V.; Kiryushin, Yu. T.; Ustinov, V. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 3, 74-6(May-June 1967). (In Russian).

Two types of high-voltage generators employed in streamer chambers are described. One generator has a corrective scheme, maximum amplitude of 400 kV, discharge capacity 500 pF, and a front pulse >10 nsec; and the other generator has an accelerated rate under pressure, maximum amplitude of 300 kV, discharge capacity 140 pF, and front pulse 4 nsec. Cosmic particle track pictures are shown. The mean length of streamers in both generators was 2 to 3 mm. (R.V.J.)

45402 INPUT DEVICE FOR THE SPECTROMETRIC SYSTEM OF SEMICONDUCTOR DETECTORS. Basiladze, S. G.; Kolpakov, I. F. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 3, 70-3(May-June 1967). (In Russian).

An input system was designed for semiconductor detector telescopes employed for recording strong ionizing particles. The system is capable of pulse-height analysis of the passing particles in four layers of the detectors. (tr-auth)

45403 SIMPLIFIED SCHEME FOR DIGITAL STABILIZATION OF MULTICHANNEL GAMMA-SPECTROMETER. Efimchik, M. K.; Podol'nyi, E. I.; Chernyavskii, A. F. (Belorussian State Univ., Minsk). Prib. Tekh. Eksp., No. 3, 67-9(May-June 1967). (In Russian).

A digital stabilization system was developed for a scintillation γ spectrometer. The stabilization coefficient was evaluated according to the γ spectrum peak position. The amplification coefficient control was attained by an attenuator based on photoresistance. With the reading in the peak channel equal to $\sim 10^4$ the coefficient of the stabilization system was ~50. (tr-auth)

45404 TRACKING SPARK CHAMBER WITH ISOTROPIC PROPERTIES FOR STUDYING HIGH-ENERGY NUCLEAR INTERACTIONS. Chikovani, G. E.; Roinishvili, N. N.; Mikhailov, V. A.; Dzhavrishvili, A. K. pp 63-75 of Yadernye Vzaimodeistviya pri Vysokikh Energiyakh. Tbilisi, USSR, Metsniereba Publishing House, 1966. (In Russian).

In the tracking chamber with isotropic properties developed the streamer is cut off early and the track is obtained in the form of glowing centers disposed along the particle trajectory. Experiments were conducted to reduce the streamer length to a minimum to give the chamber maximum isotropic properties. With an increase in field intensity from 8 to 14 kV/cm the number of streamers rose very slowly from 1.4 to 2/cm; the mean-square deviation of the streamers from the particle trajectory was practically unchanged at about 0.3 mm (at a delay of the high-voltage pulse of 1 μsec). (JPRS)

45405 PROGRAM FOR PROCESSING CHARGED-PARTICLE TRACKS IN A MAGNETIC CLOUD CHAMBER ON THE BESM-2 COMPUTER. Tarkashvili, Ts. T. pp 96-115 of Yadernye Vzaimodeistviya pri Vysokikh Energiyakh. Tbilisi, USSR, Metsniereba Publishing House, 1966. (In Russian).

The experimental data (charged-particle tracks) are processed to calculate the particle momentum with consideration of the inhomogeneity of the magnetic field and to determine the trajectories of particles in space. The program was executed in the instruction code of a BESM-2 computer and installed completely in its rapid storage, occupying cells 0001–2417. It consists basically of eight interconnected subprograms. The machine time for one track is one minute. (JPRS)

45406 PHASE HOLOGRAMS OF BUBBLE AND EMULSION CHAMBER TRACKS AND THE POSSIBILITIES OF PROCESSING THEM. Komar, A. P.; Stabnikov, M. V.; Turukhano, B. G. (Ioffe Inst. of Physics and Tech., Leningrad). Dokl. Akad. Nauk SSSR, 174: 1052-3(June 11, 1967). (In Russian).

Holograms of artificial particle tracks in bubble chambers were produced and evaluated. The main advantage of this technique is the ability to differentiate in depth between the various tracks. Thus, the background of undesirable tracks can be effectively eliminated from the photograph. For these experiments artificial tracks were produced in a gelatine bubble chamber. These tracks can be preserved over an extended period of time (5–10 minutes) and are practically indistinguishable from the actual particle tracks. The holograms were produced using a helium-neon laser. The depth of focus on the reconstructed holograms was very small. The random effects (scratches, etc.) were not visible, hence both the diffraction and the amplitude background effects were practically absent. An expression for the depth of focus is given. The resolution of the reconstructed images is determined only by the resolution of the photographic material, and not by the hologram. Analogously, holograms of particle tracks in a developed emulsion can also be produced. It is noted that the processing of track information and track selection can be radically improved by using optical filters in conjunction with holograms. (ATD)

45407 SELECTION OF THE DEAD TIME OF THE RADIO CHANNEL OF A NEUTRON SUPERMONITOR. Kapustin, I. N. (Polar Geophysical Inst., Academy of Sciences, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 125-8(1967).

Translated from Geomagn. Aeronomiya, 7: 165-9(1967).

The influence of dead time instability on the instrumental accuracy of a supermonitor is analyzed. A circuit for compensating count losses that substantially reduces the instrument error is described. (auth)

45408 DISCRIMINATION FOR PARTICLES WITH ENERGIES BELOW 10 MeV BY A FUNCTION GENERATOR ASSOCIATED WITH A ΔE, E TELESCOPE. Vautrin, J. P.; Graff, J.; Thirion, J. M.; Chouraqui, G.; Port, M. (Institut de Recherches Nucleaires, Strasbourg). Nucl. Instrum. Methods, 55: 358-64(Oct. 1967). (In French).

Non-linear amplifiers based on the logarithmic $I_E V_{EB}$ response of transistors are used to generate the function $(E + \Delta E)^n - E^n$ from the ΔE and E pulses delivered by a telescope counter. The value of this function is practically independent of the particle energy but depends strongly on the mass. This allows the discrimination of particles which differ by their masses. With the precise value n = 1.6 the discrimination becomes possible in the energy range below 10 MeV. In order to generate the discrimination function with a reliable accuracy, the logarithmic transistors are located in a constant temperature enclosure. With logical circuits the storage of energy and mass spectra is possible. Besides, a triple coincidence circuit gives the possibility to clean out the energy spectra, only the pulses corresponding to the selected particles being then recorded. (auth)

45409 USE OF AN ELECTRONIC INTEGRATOR TO CONTROL THE MAGNETIC FIELD IN A BETA SPECTROMETER. Larsen, J. T.; Layman, J. W.; Talbert, W. L. Jr. (Ames Lab., Iowa). Contract W-7405-eng-82. Nucl. Instrum. Methods, 55: 333-8(Oct. 1967). (IS-1560).

A field control system is described for a high-resolution beta-ray spectrometer. The system is based upon the detection of imbalance between a standard coil field and the spectrometer field itself, with electronic integration of the error signal to provide a reference voltage for the spectrometer power supply. Performance of the system is presented along with a discussion of application to ion-beam handling systems. (auth)

45410 METHOD OF ABSOLUTE GAMMA SOURCES ACTIVITY MEASUREMENT USING A SCINTILLATION COUNTER IN FIXED GEOMETRY. Zarnowiecki, K. (Inst. of Nuclear Research, Swierk, Poland). Nucl. Instrum. Methods, 55: 329-32 (Oct. 1967).

It was calculated that the efficiency of a gamma scintillation counter is lower than the one obtained from a simple exponential formula. The influence of the escape of fluorescence x-rays and annihilation photons and the presence of low energy Compton electrons was taken into account. It was proved that a counter in the collimated beam geometry can be used for absolute measurements of gamma source activity. The method of calculating the correction factors for filters, and a collimator permeability is given. The experimental results agree very well with theoretical calculations. (auth)

45411 LIFETIME MEASUREMENTS IN THE PICOSECOND RANGE USING COINCIDENCE TECHNIQUE. Berlovich, E. E.; Lukashevich, V. V. (Ioffe Inst. of Physics and Tech., Leningrad). Nucl. Instrum. Methods, 55: 323-8(Oct. 1967).

A method for elimination of instrumental shifts is suggested. It is based on the use of two converters situated on the variable delay line in the linear parts of the time-to-amplitude conversion curve. Delayed coincidence curves obtained by means of two converters are displaced with respect to the prompt coincidence curve in opposite directions, while the instrumental effects displace them in the same direction. The sum of the curve centroid shifts for both converters corresponds to the double lifetime. The half life of the 686 keV level in ^{187}Re was measured and found to be $T_{\frac{1}{2}} = (1.3 \pm 0.3) \times 10^{-11}$ s. Areas and first order moments of coincidence curves were determined directly in measurements by means of two scalers, one of which reads out the pulses fed to the analyzer's memory, while the other reads out the number of pulses in pulse trains, choosing the channel number. (auth)

45412 FAST PULSE HEIGHT DISCRIMINATOR WITH COMPENSATION OF RISE TIME AND THRESHOLD EFFECT. Jung, H.; Bruellmann, M.; Meier, D. (Eidgenossische Technische Hochschule, Zurich). Nucl. Instrum. Methods, 55: 301-22(Oct. 1967). (In German).

Variations in the amplitude of pulses give rise to time dispersion in a subsequent pulse-height discriminator. This is due to two factors, namely the finite pulse rise-time and the nonideal behavior of the discriminator. A pulse-height discriminator is described which electronically effects a compensation for the time dispersion. It is designed for pulses which have a common rise-time T_R between 0.5 and 5 ns. The discriminator threshold can be set to any desired height from 1.6V to over 5V. The threshold width is below 50 mV. For pulses with T_R = 5 ns, the maximum time dispersion lies below ±50 ps for amplitude variations between 0 and 15V and frequency variations between 0 and 100 kHz. The discriminator was designed for a fast neutron time-of-flight spectrometer, with a view to reducing the line broadening caused by the continuous pulse-height spectrum of the neutron detector. The spectrometer, based upon the associated-particle technique, is briefly described. The full width at half height of the coincident neutron spectrum is smaller than 0.7 ns for a scintillator thickness d = 1 cm, and is virtually independent of the threshold energy. (auth)

45413 DEAD-TIME CORRECTIONS FOR SLOW COUNTING SYSTEMS. Crannell, H.; Danforth, D. (Stanford Univ., Calif.). Contract Nonr 225(67). Nucl. Instrum. Methods, 55: 372-6 (Oct. 1967).

The problems of correcting for counting-rate losses incurred by using detectors that can record only one event in the duration of the accelerator pulse are discussed. A method of accurately determining the dead-time losses in high counting rate situations, even when the beam intensity varies rapidly, is developed and experimental results are presented. Calculations of the statistical accuracy that can be achieved as a function of counting rate are shown. (auth)

45414 SOME REMARKS ON THE SCINTILLATOR–PM SYSTEM ANALYSIS FOR TIMING. Cocchi, M.; Rota, A. (EURATOM, Ispra, Italy). Nucl. Instrum. Methods, 55: 365-71(Oct. 1967).

Some of the models which have been proposed to study the behavior of the scintillator-PM system for time measurements are briefly described and critically examined. The models based on inductive criteria seem to allow a better description of the real system. The comparison between "inductive" and "deductive" methods is performed on the basis of theoretical considerations and experimental results. (auth)

45415 METHOD FOR NEUTRON DETECTION EFFICIENCY MEASUREMENTS AND NEUTRON–CHARGED PARTICLE COINCIDENCE DETECTION. Jackson, W. R. (Rice Univ., Houston, Tex.); Divatia, A. S.; Bonner, B. E.; (and others). Contract AT(40-1)-1316. Nucl. Instrum. Methods, 55: 348-59(Oct. 1967). (ORO–1316-31).

A simple and straighforward method for experimentally determining neutron time-of-flight detector threshold and efficiency as a function of neutron energy is presented. A procedure for neutron-charged particle coincidence studies is included also. (auth)

45416 CdTe AS A GAMMA DETECTOR. Akutagawa, W.; Zanio, K.; Mayer, J. W. (Hughes Research Labs., Malibu, Calif.). Nucl. Instrum. Methods, 55: 383-5(Oct. 1967).

Carrier trapping effects dominate the response of semi-insulating CdTe and GaAs to nuclear particles. The trapping effects of these semi-insulators are studied using alpha particles. It is found that photopeaks can be resolved with degraded resolution under conditions of less than full collection. (auth)

45417 GAS PROPORTIONAL COUNTER FOR DETERMINATION OF LOW LEVEL ^{3}H AND ^{14}C IN SMALL SAMPLES. Tykva, R. (Inst. of Organic Chemistry and Biochemistry, Prague); Kokta, L. Nucl. Instrum. Methods, 55: 381-2(Oct. 1967).

The construction of a low-background internal gas proportional counter with anticoincidence shielding of a plastic scintillator is

described. If natural gas (98 vol. % CH_4) is used as the flow gas, the background of the counter (effective volume of 52.4 ml) is 0.29 ± 0.03 cpm under a 10 cm lead shield. (auth)

45418 SPECIAL SYSTEM OF PROPORTIONAL COUNTERS TO BE USED AS A HIGH PRESSURE GAS TARGET WITHOUT WALLS. Alberigi Quaranta, A. (Univ., Bologna. Istituto Nazionale di Fisica Nucleare, Bologna); Bertin, A.; Matone, G.; Palmonari, F.; Placci, A.; Dalpiaz, P.; Zavattini, E. Nucl. Instrum. Methods, 55: 273-87(Oct. 1967).

A special assembly of high pressure wire proportional counters is described. Their operation defines a volume in a gaseous target, the effective limits of which are set mainly by the electric fields of the counters and not by a continuous material wall. The apparatus, used in a recent experiment—at the CERN 600 MeV synchrocyclotron—while filled with extremely purified hydrogen, is fitted to work with any gas, or mixture of gases, proper to fill gas proportional counters. The device seems suitable to be used in different fields of high-energy physics. (auth)

45419 IMPROVED SCINTILLATION PROBE FOR EFFICIENT COUNTING OF LOW ENERGY BETA RAYS. Muramatsu, M.; Shigematsu, A.; Tokunaga, N. (Tokyo Metropolitan Univ. Research Inst. of Tuberculosis, Tokyo. Japan Radiation and Medical Electronics, Inc., Tokyo). Nucl. Instrum. Methods, 55: 249-52(Oct. 1967).

It was shown that the radioactivity of low energy beta emitters such as tritium and ^{14}C are determined very reliably, easily and rapidly by evacuating the space between the surfaces of sample and scintillator sheet of a scintillation probe, in which the sheet is combined with a prismatic light guide for dividing and transmitting the optical scintillae into two phototubes. Owing to the evacuation, counting of radioactivity was achieved very efficiently with tritiated samples, even when they are far from the scintillator surface. It was also shown that the count rate is doubled by placing a tritiated specimen on a scintillator bed for counting the downward radiation. In the case of ^{14}C-labelled specimens, 97% was found for the overall counting efficiency obtainable by this procedure. (auth)

45420 UNIFORMITY OF RESPONSE OF LARGE PLASTIC SCINTILLATION COUNTERS TO MINIMUM IONIZING PARTICLES. Grieder, P. K. F. (Univ., Bern). Nucl. Instrum. Methods, 55: 295-300(Oct. 1967).

Pulse height distributions were measured as a function of position on five different scintillation counter modules for minimum ionizing particles, and the uniformity of the counters was determined. Two of the counters were equipped with two light guide–photomultiplier assemblies and the current pulses of the corresponding photomultipliers were added, in an attempt to improve the uniformity. Detailed characteristics of the counters are presented and the results summarized. The merits of employing two or more light guide–photomultiplier assemblies on a single large scintillator sheet are discussed. (auth)

45421 SLOW NEUTRON SPECTRUM MEASUREMENT WITH A LiF SINGLE CRYSTAL AS MONOCHROMATOR. Rossitto, F.; Terrani, M. (CESNEF, Milan). Nucl. Instrum. Methods, 55: 288-94(Oct. 1967).

A detailed description of slow neutron spectrum measurement, employing LiF as monochromator, is given. The correction factors to be applied to the counting rate obtained, some of which cannot be found at present in the literature, are separately evaluated and discussed. (auth)

45422 RECOIL PROTON COUNTER FOR NEUTRON FLUX MEASUREMENT. Muthukrishnan, G.; Murthy, K. B. S.; Sunta, C. M. (Bhabha Atomic Research Centre, Bombay). Nucl. Instrum. Methods, 55: 269-72(Oct. 1967).

A counter for neutron flux measurement was developed with uniform response from 0.5–14 MeV using the technique of recoil proton counting. The counter is filled with a hydrogenous gas and lined inside with polythene sheets of two different thicknesses which act as proton radiators. The energy response of the counter has been tested experimentally using monoenergetic neutrons. (auth)

45423 ENERGY DEPENDENCE OF THE PULSE HEIGHT DEFECT IN SILICON PARTICLE DETECTORS. Krulisch, A. H.; Axtmann, R. C. (Princeton Univ., N. J.). Contract AT(30-1)-2807. Nucl. Instrum. Methods, 55: 238-48(Oct. 1967). (NYO-2807-32).

The pulse height response of silicon surface-barrier detectors was measured for median light and heavy fission fragments at average energies from 7 to 102 MeV. The fragment energies were determined by a time-of-flight technique. Comparison of the detectors' response to fission fragments with that to alpha particles yielded Δ, the pulse height defect. The results indicate that an appreciable fraction of Δ is due to recombination losses within the ionization column produced by the fragment. The contribution to Δ from this cause decreases approximately linearly with fragment energy. In the energy realm where nonionizing nuclear collisions occur, Δ decreases sharply at initial energies below 25 MeV. An empirical energy calibration method proposed by Schmitt et al. for fission fragments with undegraded energies gave good agreement with the time-of-flight data in the energy range 25–100 MeV. A further empirical procedure is proposed for energies below 25 MeV. (auth)

45424 PROBLEMS ENCOUNTERED IN LIQUID SCINTILLATION COUNTING. Roberts, W. A. (Beckman Instruments Ltd., London). Bio-Med. Eng., 2: 82-4(Feb. 1967).

Problems which may occur in the detectors, electronic circuits, and mechanical features of liquid scintillation counting equipment are discussed. The first source of energy loss is in the energy conversion efficiency of the capture mechanism. Ideally, after β-particle capture, photons are emitted, but the change in energy level may also result in the emission of phonons, which is a wasted interaction. In certain chemical combinations the photon/phonon ratio is changed in the unfavorable direction, and this is a principal source of error: a reduction in the output of light photons generally termed chemical quenching. A second source of error is color quenching. Efficiencies of liquid scintillators are discussed, as well as the problem of quenching, or loss of light photons with a resulting decrease in the counting efficiency. This is compounded from all the foregoing sources of error, but is mainly due to color and chemical quenching. Problems encountered in the photomultiplication process considered are the efficiency of the dynodes in their secondary emission role, electrons impinging on the glass wall or extreme edges of the dynodes, producing spurious pulses, electrons randomly emitted from the photocathode and dynodes as a thermal characteristic, and the speed of travel of the pulse down the tube, which limits the rate of pulses that the device can handle. (BBB)

45425 PORTABLE ANALYZER RANGE EXTENDED. Eng. Mining J., 168: 98(July 1967).

An account is given of improvements in and use of the portable isotope fluorescence analyzer. Its use was extended appreciably and measurements in situ correspond well enough with chemical determinations to the extent that it can be relied upon to give an immediate semi-quantitative analysis. Measurements on Cu ores involved use of a $^{3}H-Zr$ source for mineral particle excitation rather than the $^{147}Pm-Al$ source found in the tin analyzer. However, it was found that greater sensitivity could be obtained by arranging the source in an annular pattern and, at the same time, enhance the instrument's limit of detection. Using a 15-Ci source on ores, with Ni and Co filters, a limit of detection of 0.25% Cu resulted. Increasing Fe content in the ore affected the apparent Cu content, and where iron varies over a wide range, more than one calibration curve is needed to give precise results. By using Cu and Ni filters in the instrument and the annular $^{3}H-Zr$ source, Zn could be determined with a limit of detection about 0.25% Zn. With appreciable Cu in the Zn ore a small correction must be applied to counteract the detection of the Cu K-shell β, as well as the Zn K-shell α radiation. Corrective tables are easily prepared, based on separate measurements of the Cu content. For widely varying Zn–Pb ores other calibration curves are required which allow for the strong absorption of Zn K-shell α x rays by Pb. A ^{57}Co source, coupled to Ir and Re filters, permitted Pb determinations to about 0.1%. High-energy secondary radiation negated grain size effects and allowed much greater penetration. Molybdenum ores are being tested with a ^{109}Cd source and Zr and Yt filters. Limits of detection indicated by preliminary results are in the order of 0.05% Mo, and interference from associated elements is not expected. (BBB)

45426 EFFICIENCY OF A LIQUID IONIZATION CHAMBER AS A FUNCTION OF THE IONIZING RADIATION QUANTUM ENERGY. Januszajtis, Andrzej. Danzig, Danzig Polytechnic Inst., 1965. (In Polish).

Thesis.

An experimental investigation was made of the dependence of hexane-filled ionization chamber efficiency on the x-ray and gamma radiation quantum energy in the range 0.018–1.25 MeV. The results obtained are in agreement with a theoretical formula derived previously. A double liquid-air dosimetric chamber giving readings independent of the quantum energy was constructed and tested on the basis of the results obtained. The radioactive isotopes thulium 170, indium 114, tin 113, caesium 137, manganese 54, zinc 65 and cobalt 60 were used as radiation standards with strictly defined energy. (JPRS)

45427 RADIATION DETECTOR HIGH VOLTAGE SUPPLY. (to Atomic Energy of Canada Ltd.). British Patent 1,086,072. Oct. 4, 1967. Priority date Mar. 1, 1965, United States.

A high-voltage power supply for a radiation detector is described. It is comprised of input terminals adapted for connection to a source of relatively low dc voltage and output terminals for connection to the anode and cathode terminals of a radiation detecting element; an oscillator having a normally low free-running frequency connected to the input terminals and adapted to convert the low dc voltage to ac voltage and increasing and rectifying the ac voltage connected between the output of the oscillator and an output terminal of the power supply; and a triggering circuit between an output terminal and the oscillator for increasing the frequency of the oscillator above the free-running frequency in accordance with the current pulse rate of the radiation detecting element. (B.G.D.)

45428 NEUTRON DETECTOR. Gourdon, Jean (to Commissariat a l'Energie Atomique). British Patent 1,085,820. Oct. 4, 1967. Priority date Dec. 16, 1964, France.

A neutron detector is described which comprises a film of fissile material, a semiconductor layer parallel to the film to detect fission fragments, and provision for counting the pulses produced by the semiconductor layer. (B.G.D.)

45429 LIGHT SPOT APPARATUS. Palmer, R. B. (to U. S. Atomic Energy Commission). U. S. Patent 3,345,120. Oct. 3, 1967.

An apparatus for scanning bubble chamber pictures for rapid electronic recording, interpretation, and selection of selected tracks therefrom is described. The apparatus uses optical light transmitting elements which produce a moving light spot by illuminating the small area of intersection of the projections of a stationary glass fiber and a glass fiber curved radially outwardly on a rotatable disc. (AEC)

45430 A 4π BETA-RAY SEMICONDUCTOR SPECTROMETER: THE INNER BETA SPECTRUM OF ^{170}Tm. Spejewski, Eugene Henry. Bloomington, Ind., Indiana Univ., 1966. 75p.

Thesis.

A semiconductor spectrometer for the measurement of beta-spectrum shapes is described. Fully depleted, lithium-drifted silicon detectors were specially designed to make possible a 4π geometry, and to enable placing of the source on the detector surface. Electronics appropriate to the measurement of beta spectra with maximum resolution, and to the measurement of inner beta spectra is described. Experiments were conducted to test the linearity and electronic stability of the system. The spectrometer has excellent linearity. The maximum drift occurring was less than 0.24% during a two-week period. The possible effects of source size and detector separation upon the measurement of beta spectra were tested by employing sources of ^{143}Pr. The results indicate that the response of the spectrometer for all sources up to 3 mm. in diameter is identical. They also show that a detector separation of as little as 0.03 mm. distorts the spectrum, causing it to have an apparent excess of low-energy electrons. The spectrometer was further tested by measuring the shapes of several beta spectra, and comparing the results to those obtained by previous investigators. The shape factor data of the ^{143}Pr beta spectrum were well fitted by a shape of the form 1 + 0.3/W. This is in good agreement with two previous measurements, but does not agree with a third. In this last case, however, there is some question of the reliability of the measuring instrument. The shape of the ^{185}W spectrum is statistical, corresponding to the previously reported results. The measured beta spectrum of RaE is also in good agreement with all other reported measurements. The coincidence circuitry was tested by employing a ^{207}Bi source. By gating on the 570-keV gamma-ray photopeak, and that portion of the 1064-keV Compton distribution beneath it, resolving curves were obtained for three electron energies and for a number of different resolving time settings. The results indicate that the time response of the electronics is independent of pulse size. All resolving curves were flat-topped for times ranging from 10 nsec. to 300 nsec., depending upon the resolving time setting. The coincidence efficiency was tested by measuring two inner group beta spectra. The beta spectrum of ^{198}Au was measured in coincidence with the 412-keV gamma ray. The resulting shape factor plot was fitted with a shape of the form 1 + aW, the best fit being obtained for a = −0.073 ± 0.008. This agrees very well with most measurements made of this spectrum. The beta spectrum of ^{86}Rb was measured in coincidence with the 1.08-MeV gamma ray. The shape of this spectrum is statistical, in agreement with all previous measurements. These two results indicate that the coincidence efficiency is also independent of pulse size. All of the experiments indicate that the 4π semiconductor spectrometer is a valid, accurate instrument for the measurement of beta spectrum shapes. The beta spectrum of ^{170}Tm was measured in coincidence with the 84-keV gamma ray, under the same measurement conditions as for the ^{198}Au and ^{86}Rb experiments. The Fermi–Kurie plot at lower energies falls below the straight line representing the statistical shape reported by previous investigators. The shape factor data were fitted with a polynomial of the form $1 + aW + b/W + cW^2$. The best fit was obtained for a = 1.11, b = −0.85, and c = −0.24. This non-statistical shape appears to be more consistent with the experimentally determined values of the beta–gamma directional correlation coefficient and of the comparative half life than is the statistical shape. The endpoint of this inner beta spectrum was determined to be 879 ± 7 keV. (Disser. Abstr.)

45431 IMPROVEMENTS IN AND RELATING TO RADIATION DETECTORS. (to Honeywell Inc.). British Patent 1,083,397. Sept. 13, 1967. Priority date Oct. 9, 1964, United States.

Design of a low-voltage Geiger–Mueller detector is presented. Spurious counts, common to Geiger–Mueller detectors, are minimized by adjustment of the discharge-region width and utilization of an auxiliary pair of electrodes. Penning mixtures are used in the detector described. (W.H.K.)

45432 IONISATION CHAMBER. (to Gesellschaft fuer Strahlenforschung mbH). British Patent 1,088,943. Oct. 25, 1967. Priority date Jan. 22, 1964, Germany.

The design of a miniature parallel-plate ionization chamber is presented. Homogeneity of the electric field between the electrodes is accomplished by maintaining a potential gradient on the chamber walls between the electrodes. (W.H.K.)

Radiation Dosimeters

Refer also to abstracts 45334 and 45371.

45433 (BNWL–481-4, pp 1-7) AQUATIC ENVIRONMENT DOSE RATE MONITOR. Porter, N. S. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Measurement of the external dose rate to fish living in reactor effluent waters is of importance to aquatic biologists studying the effects of radioactivity on these vertebrates. A waterproof scintillation detector, coupled to an operational amplifier, a dose rate meter, high and low voltage power supplies, and a strip-chart recorder comprise the completed system developed for this purpose. The detector comprises a 3 in. diam by 3 in. long plastic scintillator coupled to a 2 in. diam photomultiplier tube in a waterproof aluminum housing. At 0.1 mR/hr, the relative accuracy of the instrument, as compared with radium calibration sources, is +15%, but it is nominally better than ±10% over the upper ranges. With the exception of the photomultiplier and corona regulator tubes, all circuits and components are solid state. The completed instrument provides the required dose rate measurements from 0.1 to 10 mR/hr. (auth)

45434 (BNWL–481-4, pp 7-11) MINIATURE DOSE RATE MEASUREMENT INSTRUMENT. Sheen, E. M.; Ratcliffe, C. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

An improved miniature pocket-size dose rate measuring instrument provides continuous meter and aural indication of the dose rate and has a high intensity selectable aural alarm. This instrument employs a G–M tube detector, 3-decade log-count-rate meter, and a 3 range linear count rate selectable alarm circuit. Circuits were designed to operate from either a 4- or 9-V Mercury battery to permit trade-off between aural output power and battery life. For low dose rates, the power consumption is only 10 or 25 mW when operated from the 4- or 9-V batteries, respectively. The circuitry design permits the log-rate indication to be optionally omitted without modification of the linear alarm trip circuit. Continuous aural indication is also optional and, if used, it is electronically inhibited during the high intensity alarm output (wailing) to increase the apparent output sound intensity. (auth)

45435 (BNWL–481-4, pp 16-23) MEASUREMENT OF MIXED-FIELD NEUTRON AND GAMMA DOSE RATES. Philipp, L. D. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The existence of mixed neutron and gamma sources at both the reactor locations and the fuel processing centers creates the potential for radiation exposures. Those who monitor personnel working in such areas require a continuous knowledge of the neutron and gamma dose rates to establish safe exposure limits. Thus, two instruments have been developed to separately measure the dose rates. The developed instruments feature solid state circuitry, portable rechargeable battery operation, rugged construction, and detectors isolated from the main instruments with appropriate cables. Thus, measurements may be made without unnecessary exposure to personnel. The gamma dose rate information is obtained using an air-equivalent ion chamber, where the ion chamber current is transformed to a suitable dc voltage at the detector to avoid routing small currents through the cable. The gamma instrument has been tested for temperature depen-

dence, neutron response, and energy dependence with satisfactory results. The neutron instrument features a calibrated polyethylene sphere with solid-state surface-barrier detectors (covered by lithium fluoride foils) to measure the neutron dose rate. Signal pulses from the five solid state detectors are amplified and combined at the detection assembly and the resultant pulses are routed to a count rate meter in the main instrument. Calibration tests have been completed. (auth)

45436 THERMOLUMINESCENCE, LOW RADIATION DOSAGE, AND BLACK-BODY RADIATION. Burch, William M. (Cancer Inst., Melbourne). Phys. Med. Biol., 12: 523-30(Oct. 1967).

It is shown that the emission of quanta in the visible region by the heating unit of a thermoluminescence reader is a major source of spurious signal in observations of low radiation dosage. At a heater temperature of 300°C about 120 photoelectrons per second are emitted from an S11 photomultiplier cathode for a typical reader construction. A quantum response tail for the cathode, extending into the infrared, is also discussed as a possible source of spurious signal. It is shown that with careful optical filtering, and by cooling the photomultiplier tube to a dark-current plateau region, the lower limit of observation of thermoluminescence signals can be extended. (auth)

45437 INSPECTION OF γ-RAY SOURCE PURITY BY ABSORBER METHOD. Kato, Akira; Yamachi, Iwao; Ibaraki, Yasuyuki. Denki Shikensho Iho, 31: 667-74(May 1967). (In Japanese).

At the Electrotechnical Laboratory ^{60}Co, ^{137}Cs and Ra γ-ray sources to be used for calibration of dosimeters are inspected by the absorber method, in which the ratio K of the penetration γ-ray emitted from the pure source through the lead absorber to that of the source to be inspected is measured. As a result of theoretical calculation of ratio K it is concluded that, so far as the energy of γ-ray emitted from common existing sources is concerned, the purity of the source to be inspected is higher than the tolerance value provided the measured value of ratio K is smaller than the value corresponding to the tolerance purity. (auth)

45438 IMPROVEMENTS IN OR RELATING TO FILM CODING DEVICES. Muzlish, Philip (to United Kingdom Atomic Energy Authority). British Patent 1,088,762. Oct. 25, 1967. Filed May 22, 1964.

A film coding device for producing coded markings on photographic films used for radiation dosimetry is described. The apparatus is primarily used for x-ray coding of personnel film dosimeters. (W.H.K.)

Radiometric Instruments

45439 INDUSTRIAL USE OF RADIOISOTOPE DEVICES IN JAPAN. Gerrard, Martha. Isotop. Radiat. Technol., 4: 195-7 (Winter 1966-1967).

The reasons given by a number of Japanese industrialists for their failure to fully exploit radioisotope devices are summarized. They are derived from a questionnaire sent to 746 organizations by the Japan Radioisotope Association in January 1964. Of the 84% who replied 36% were using radioisotope devices. Of the 547 instruments in use 25% were imported. All of the vacuum and gas chromatography meters and leak detectors were imported, 17% of the thickness gages, 14% of the level gages, but none of the snowfall meters. Lack of need, adequacy of other methods, and high cost were among the reasons given for not using the devices. (M.M.B.)

45440 NEW IMPROVED RADIOACTIVE VISCOSIMETER. Fuia, H. N.; Ponner, I. I. (Polytechnical Inst., Bucharest). Bul. Inst. Politeh. Bucuresti, 29: 73-8(Jan.-Feb. 1967).

The proposed radioactive viscosimeter relies on the principle of a ball sinking in the liquid under investigation. The ball sinking rate is determined t by measuring a set of r(t) counting rate values depending on ball sinking time with an electronic scaler–detector commanded by an astable multivibrator. Device calibration is carried out by measuring r(x) counting rate function of x-depth at which the ball is suspended in liquid. The accuracy at silicone oil (OE 4018/100.000) viscosity coefficient determination with this viscosimeter is under 2%. (auth)

45441 ADVANCED NUCLEAR GAGE CONTROLS PROCESS MOISTURE. Reim, T. E. Instr. Technol., 14: 47-51(July 1967).

Design and construction of a nuclear gage to measure and control moisture in raw materials on conveyors are described. Of various moisture gaging techniques for ore, coal, and coke processing that were investigated, a nuclear gaging system was found to be most satisfactory if neutron and γ-ray transmission techniques were used rather than conventional backscattering gaging. The basic gaging principle of this new approach to moisture measurements is explained. A nuclear source transmits both fast neutrons and γ rays through the material. In passing through the material, the fast neutrons collide with H atoms, slowing enough to be sensed by a slow-neutron detector. This detector generates 5-mV output pulses of about 10-μsec duration. Since moisture consists of H_2O molecules, the counting rate varies directly with the amount of moisture in the gaging zone, providing an approximately linear relation. The γ rays that pass through the material, on the other hand, interact predominantly with the outer electrons of all atoms in the material. This interaction causes extensive γ-ray scattering and absorption; the γ radiation reaching the detector is inversely related to the amount of material between source and detector. An inverse, linear relation is obtained. Combination of the 2 signals thus provides a direct measure of moisture per unit weight. Experiments showed that moisture measurement was virtually independent of the thickness of the material tested. (BBB)

45442 A FUNDAMENTAL STUDY ON INDUSTRIAL MEASUREMENTS BY MEANS OF BACKSCATTERED GAMMA RAYS. PART I. Shibata, Keizo; Wakabayashi, Nobuo; Fujii, Mizuhiko; Ueda, Katsuhiko (Kobe Univ., Japan). Radioisotopes (Tokyo), 16: 204-8(May 1967). (In Japanese).

As a fundamental study of thickness, level, or density by means of backscattered gamma-rays, the spectra of the gamma rays which were scattered by steel plates with or without water behind these plates, were measured. The incoming beam from ^{137}Cs (0.1 Ci) was collimated by a hole 6 mm in diameter. The experimental condition was based on the calculated results of the intensity of single-scattered rays in the incident plane. In calculation, the geometrical condition of the apparatus (the sizes of detector and collimator etc.) was taken into account. When the scattering angle was not large, the energy spectrum showed two main peaks: the higher energy peak by single-scattered rays and the lower energy one by multiple-scattered rays. It was found that the energy band of the higher peak was suitable for thickness measurement of vessel wall. It was also possible by some ways of geometrical arrangement of the apparatus to detect mainly the scattered rays by the vessel wall. It was shown that geometrical arrangement in wall-thickness measurement by means of backscattered gamma-rays could be evaluated from the standpoint of the error caused by presence of liquid in the vessel. Hereby, the experimental results about the geometrical effects were examined, and the optimum geometrical arrangement was found. (auth)

45443 RADIOTRACER PROPELLANT GAUGE. Wakeman, J. F.; Burns, B. (TRW Systems Group, Redondo Beach, Calif.). Instrum. Contr. Syst., 40: 95-7(Mar. 1967).

Design and testing of a new zero-gravity propellant gauge system for space applications, which employs ^{85}Kr, are described. This system provides for accuracy, fast response, and high reliability under all space environmental conditions. The propellant gauge also conforms to specified power and weight limitations placed upon it by the spacecraft, as well as offering significant advantages with many types of storable propellant systems. The principle is as follows: when the tank is full of propellant, a small quantity of radioactive gas such as ^{85}Kr is injected into the ullage space, and the tank is pressurized. As the propellant is consumed, the ullage space volume increases and the volume concentration of the radioactive gas is decreased. This dilution of the gas is continuously measured, and the measured count rate, being proportional to the ^{85}Kr concentration, is related to the amount of propellant remaining. A data processor receives pulses directly from the detector assemblies in the fuel tank. The pulses are counted for 10 sec. From the counts obtained, the amount of propellant remaining in each tank is computed along with the mixture ratio of the propellants remaining in the tanks. This information is then transmitted to the display electronics. The typical average gauging error throughout the entire range of propellant expulsion was less than ±3%. Since ^{85}Kr emits low energy β radiation, and a small fraction of γ rays (0.4%), personnel hazards are considered negligible. Krypton-85 is considered the safest isotope for many uses, since there is virtually no bodily retention of the isotope. Even if the pressurizing gas, containing 10 mCi of ^{85}Kr, were released into the air, little hazard would exist due to its dilution upon release. The radiotracer propellant gauge was tested with a full-scale model of the Apollo Reaction Control System tankage that can be rotated about the horizontal axis. (BBB)

45444 DESIGN OF A ^{63}Ni ELECTRON ABSORPTION DETECTOR AND ANALYTICAL SIGNIFICANCE OF HIGH TEMPERATURE OPERATION. Simmonds, P. G.; Fenimore, D. C.; Pettitt, B. C.; Lovelock, J. E.; Zlatkis, Albert (Univ. of Houston, Tex.). Anal. Chem., 39: 1428-33(Oct. 1967).

An electron absorption detector which incorporates a ^{63}Ni

source was designed for safe operation to 400°C. The analytical advantages of high temperature operation were studied so as to extend the general utility of this class of detector in gas chromatography. Expansion of the practical temperature range reduces detector contamination and provides a broader insight into the temperature dependency phenomena observed for certain compounds. Moreover, the new design retains all of the desirable performance characteristics of the established Lovelock parallel plate electron capture detector when operated in the pulsed sampling mode. (auth)

45445 RADIOIZOTOPNAYA AVTOMATIKA V KUZNECHNO-SHTAMPOVOCHNOM PROIZVODSTVE. (Radioisotopic Automation in Forging–Die Industry). Artes, A. E. Moscow, Atomizdat, 1967. 180p.

The latest possibilities for the development of automation systems using radioisotopes were described. The results of scientific studies and pilot installations using these new automation systems are also reported. On the basis of the exploitation of a series of installations with radioisotopic devices, practical recommendations were given for their future installation and use. Their economic efficiency was also considered. (tr-auth)

45446 THE RADIOACTIVE FOIL ELECTRON CAPTURE DETECTOR: THEORETICAL AND EMPIRICAL STUDY OF SENSITIVITY TO PRESSURE, TEMPERATURE, AND GAS FLOW RATE. Scolnick, Martin (Varian Aerograph, Walnut Creek, Calif.). 22p. (CONF-670308-3). DTIE.

From 18th Conference on Analytical Chemistry and Spectroscopy, Pittsburgh.

An investigation to determine the role of carrier gas pressure, flow rate, and temperature in the operation of a radioactive-foil electron-capture detector is presented. An approximate theoretical equation was obtained which describes standing current in terms of voltage and two parameters which were found experimentally to be functions of gas pressure and temperature. Standing current was found to be insensitive to carrier-gas flow rate. (W.H.K.)

45447 III KRAJOWE SYMPOZJUM ZASTOSOWAN IZOTOPOW W TECHNICE, SZCZECIN, 31 V–3 VI 1966. (Third National Symposium on Application of Isotopes in Technology, Stettin, Poland, May 31–June 3, 1966). [Warsaw, Palac Kultury i Nauki, 1966]. 850p. (CONF-660571-(Pt.1)).

The conference included 159 papers on the applications of radioisotopes. These applications include radiometric instruments, tracer techniques, radiometric methods of analysis, neutron sources and other radiation sources, etc. Papers 1 through 85, inclusive, are contained in part I. (C.E.S.)

45448 III KRAJOWE SYMPOZJUM ZASTOSOWAN IZOTOPOW W TECHNICE, SZCZECIN, 31 V–3 VI 1966. (Third National Symposium on Application of Isotopes in Technology, Stettin, Poland, May 31–June 3, 1966). [Warsaw, Palac Kultury i Nauki, 1966]. 850p. (CONF-660571-(Pt.2)).

The conference included 159 papers on the applications of radioisotopes. These applications include radiometric instruments, tracer techniques, radiometric methods of analysis, neutron sources and other radiation sources, etc. Papers 78 through 159, inclusive, are contained in part II. (C.E.S.)

Miscellaneous Instruments and Components

Refer also to abstract 45345.

45449 (BNL–11794) SIGNAL PROCESSING FOR HIGH-RESOLUTION PULSE AMPLITUDE SPECTROMETRY. Radeka, V. (Brookhaven National Lab., Upton, N. Y.). [1967]. 26p. (CONF-670520–12). Dep. CFSTI.

From Conference on Semiconductor Nuclear Particle Detectors and Circuits, Gatlinburg, Tenn.

A general discussion of filters for high-rate, high-resolution pulse amplitude spectrometry is presented. Included topics are signal and noise, signal and noise processing, and rate considerations. (W.H.K.)

45450 (BNWL–481–4, pp 27-30) ANIMAL ACTIVITY MONITOR DEVELOPMENT. Wilbur, R. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The physical activity and expended energy exhibited by irradiated rodents greatly affects the biological half-life of the isotope in the test animal. A system composed of an accelerometer and a three-dimensional matrix of infrared detectors which provides expended energy and rodent positional data in digital form is described. (W.H.K.)

45451 (BNWL–481–4, pp 30–4) TIDAL VOLUME AIR MEASUREMENT. Wilbur, R. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Studies of deposition of inhaled radionuclides in canines require an accounting of the amount of air respired. The tidal volume information and the known concentration of the radionuclide aerosol yield approximate levels of deposition. Also desirable is continuous monitoring of the respiration parameters during exposure to determine changes in respiration pattern. This report describes a monitor for measuring the total number of respirations, the tidal volume per inhalation, and the tidal volume per exposure. The information is displayed on a digital printer. Volume flow is measured with a stainless steel venturi tube and a sensitive differential pressure transducer mounted in the inhalation path. The output signal of the pressure transducer is recorded on a strip chart for subsequent comparison with digital information. (auth)

45452 (BNWL–481–4, pp 46–8) IMPROVEMENTS IN RAINDROP CHARGE MEASURING SYSTEMS. Ratcliffe, C. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Improvements made in the earlier equipment are in transducer design, better charge sensitive stability, and easier field adjustment and operation. The transducer was modified to be more tolerant of breezes during the rain or snow shower being sampled. The charge sensitive amplifier was improved to provide higher gain, more stability, and an easier adjustment procedure than previously. Different cabling, connectors, and power supply arrangements have made field operation and maintenance simpler, especially when the ambient temperature is low. (auth)

45453 (CNEA–181) INTEGRADOR LOGARITMICO Y MEDIDOR DE PERIODO VELOCIDAD DE RESPUESTA Y FLUCTUACION ESTADISTICA. (Logarithmic Integrator and Period Meter: Response and Statistical Fluctuations). Battista, A.; Pinasco, S. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1967. 35p. (In Spanish). Dep.

The behavior of the logarithmic integrator, composed of a series of pump diodes, and of the period meter are analyzed. The response velocity and the statistical fluctuation of the integrator and the period meter were determined. The results are graphed. The circuit of the integrator and rate meter are given. (J.S.R.)

45454 (LRP–32/67) MESURE DE LA PRESSION PAR UN SYSTEME A THERMOCOUPLE COMPENSE ET A AMPLIFICATEUR DECOUPEUR, ALIMENTE PAR BATTERIES. (Measurement of Pressure by a Compensated Thermocouple System and a Chopper Amplifier, Powered by Batteries). Ripper, H. (Laboratoire de Recherches sur la Physique des Plasmas, Lausanne (Switzerland)). Aug. 1967. 13p. (In French). Dep.

The construction of a battery-powered gage which measures the pressure in a discharge tube is described. This gage is based on a compensated thermocouple used in conjunction with a chopper–amplifier. Typical calibration curves are shown. (auth)

45455 (LYCEN–6738, pp 42–65) UTILISATION D'UN CALCULATEUR EN LIGNE EN PHYSIQUE NUCLEAIRE. (Use of an On-Line Computer in Nuclear Physics). Corge, C. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). (In French).

The use of on-line computers in nuclear physics is illustrated by several detailed examples. The form of the information fed to the computer is considered, the data processing and the visualization units are described. Data processing and digital tracing are then discussed. The associated memory of the computer is considered. (J.S.R.)

45456 (NYO–3622–11) APPLICATIONS OF ULTRASONIC ENERGY: ULTRASONIC INSTRUMENTATION FOR NUCLEAR APPLICATIONS. Bimonthly Progress Report No. 36, August 1, 1967–September 30, 1967. (Aeroprojects, Inc., West Chester, Pa.). Oct. 1967. Contract AT(30-1)-3622. 12p. Dep. CFSTI.

The molten sodium test cell at Mine Safety Appliances Research Corporation is being modified in preparation for dynamic tests with the ultrasonic incipient boiling detector. Continued experimentation in determining liquid flow rate by measurement of the phase differences in an acoustic wave as detected by receivers located upstream and downstream from the transmitter indicated a reproducible linear relationship. This appears to be a reliable technique since the signals are relatively unaffected by turbulence in the liquid. (auth)

45457 (RL-GEN-929(Rev.1)) MULTI-PURPOSE REACTOR FUEL CHANNEL MONITORING SYSTEM. Creek, K. O. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). May 1967. Contract AT(45-1)-1350. 36p. Dep. CFSTI.

For Douglas United Nuclear, Inc., Richland, Wash.

The process tubes of the N–Reactor are corrosion-resistant

and thoroughly tested, but may be subject to damage or deterioration. Probes have been developed to assess process tube conditions in the reactor. A television probe visually examines the inner surface and measures pit or scratch depth. An ultrasonic hydride probe measures hydrogen content in the tube wall. An inner-diameter probe measures tube creep. Peripheral equipment is provided to clean and dry the tubes, and to insert the probes into the process tubes. Availability of this monitoring system will provide adequate surveillance of the integrity of the process tubes, therby allowing replacement of the process tubes before reactor operating safety is diminished. (auth)

45458 (UCRL-70285(Rev.1)) A LIGHTWEIGHT, 1-METER-DIAMETER, 11 kG, SUPERCONDUCTING MAGNET SYSTEM FOR A BALLOON-CARRIED COSMIC RAY EXPERIMENT. Taylor, Clyde E.; Nelson, Robert L.; Henning, Carl D.; Taylor, Alfred R.; Harvy, Arthur (California Univ., Livermore. Lawrence Radiation Lab.). Sept. 15, 1967. Contract W-7405-eng-48. 15p. (CONF-670705-16). Dep. CFSTI.

From 2nd International Conference on Magnet Technology, Oxford, England.

For cosmic ray studies at high altitudes a very lightweight magnet system is required, with large aperture and with magnetic field normal to the particle path. Such a coil is being built for a balloon-carried experiment. The main features of this system are: central field, 11 kG saddle-shaped split coils, free access diameter 1.0 meter, 19-strand cable with three 0.51-mm-diameter strands of Nb-Ti, current 870A, dewar exterior dimensions 1.0-M i.d. × 1.60 M o.d. × 2.46 M long, weight (coil and dewar) 1630 kg, and stored energy 1.2×10^6 J. The main features of this coil system including field configuration, structural problems, and construction details are described. The coil has not yet been tested. (auth)

45459 ELECTRON-OPTICAL IMAGE INTENSIFIER: ITS CHARACTERISTICS AND USE IN X-RAY DIAGNOSIS. Fenner, Eckhard (Siemens Aktiengesellschaft, Erlangen, Ger.). Siemens-Z., 41: 749-55(Sept. 1967). (In German).

The most important features and characteristics of the electron-optical image intensifier are dealt with both in its capacity as a radiation converter and amplifier as well as when it is being used as an image transmission system. Important for the transmission are the influencing of the object geometry and the intensity distribution in the amplified image, the background, the resolution and—as the most important characteristic for the image quality of the tube and its components—the modulation transfer function. (MTF). (auth)

45460 RADIOISOTOPIC LIFE DETECTOR FOR SPACE STUDIES. Gerrard, Martha. Isotop. Radiat. Technol., 4: 108-10(Winter 1966-1967).

The Gulliver space probe will use ^{14}C and ^{35}S in the form of labeled components of a nutrient broth to demonstrate the presence of living organisms on Mars. The technique that was developed was selected because of its sensitivity and the rapidity with which it can be carried out. (auth)

45461 NUCLEAR ELECTRONICS: A VERSATILE DELAY-GATE GENERATOR WITHOUT RECOVERY-TIME. Lauch, J.; Nachbar, H. U. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Kerntechnik, 9: 413-16(Sept. 1967). (In German).

A versatile delay-gate generator without recovery time is described. It consists of two equal generators. Each of them can be used independently for gate or delay operation, respectively. For delay-gate operation the two generators are connected in series. The two decoupled outputs of each generator are short-circuit proved and deliver −2 V into 50 Ω. The delay time and the gate duration are adjustable in four decades between 50 ns and 550 μs. The duration of the delay pulse is approximately 25 ns. The temperature coefficient of these times is less than 10^{-3} grd^{-1}. (auth)

45462 IMPROVEMENT OF CONTACTLESS HALL SENSORS USED FOR MEASUREMENTS OF BEAM INTENSITY OF CHARGED PARTICLES. Pogodin, V. I.; Shchelkin, A. P.; Yur'eva, G. A. (Inst. of Semiconductors, Leningrad). Prib. Tekh. Eksp., No. 3, 113-14(May-June 1967). (In Russian).

A method of increasing the sensitivity of Hall sensors used for contactless measurement of the intensity of direct currents of charged particle beams is described. A diametrically slotted ferrite ring is used to concentrate the magnetic field. The specimens of indium antimonide were deposited on ferrite substrates measuring $8 \times 8 \times 0.5$ mm^3, and later were polished to a thickness of ≈20 μ. These sensitive elements were installed between the half-rings of the concentrator. Such an arrangement provides a total gap of less than 50 μ, permitting the device to obtain high sensitivity at the series connection of both sensors: 35 μV/ma of the measured current, which corresponds to 0.5 μV/γ. The Hall sensors are supplied with a 1-kHz signal from a sine-wave oscillator. The sensor signal is amplified by a narrow-band amplifier, and is detected and measured by a d-c microammeter. The described device is capable of measurements of direct beam currents of 100 μamp and higher. (ATD)

45463 TIME ANALYZER FOR $\mu \rightarrow e$ DECAY STUDIES. Meleshko, E. A.; Nikol'skii, B. A.; Sokolov, B. V. (Inst. of Atomic Energy, Moscow). Prib. Tekh. Eksp., No. 3, 61-6 (May-June 1967). (In Russian).

Design and performance of a nanosecond time analyzer operating with high-energy particles are described. The device consists of input units including a scheme of fast coincidences and anticoincidences, amplitude transformer, and pulse-height analyzer. With a channel width of 2.5 nsec the differential nonlinearity of the analyzer varied ±3%; the resolving time of the analyzer measured in a passing μ-meson beam was 1.5 nsec, and the resolving time of all the basic coincidence schemes was 4 nsec. (tr-auth)

45464 SOLID STATE DRIVE CIRCUIT CONSIDERATIONS FOR PAPER-TAPE PUNCHES. Cohn, Charles Erwin (Argonne National Lab., Ill.). Rev. Sci. Instrum., 38: 1662(Nov. 1967).

Circuit modifications for paper-tape punches are presented to correct punching errors due to lag in demagnetization of the punch magnets after the transistors are turned off. The two examples presented are the DDP-24, where there is a margin of breakdown capability in the driver transistor, and the ND-160 analyzer, where no such margin exists. (W.H.K.)

45465 STABILIZATION SYSTEM FOR A TRANSISTORIZED PHOTOMULTIPLIER WITH SEMICONDUCTOR LIGHT PULSE SOURCE. Gadalov, A. N.; Mineev, Yu. V. (Moscow State Univ.). Prib. Tekh. Eksp., No. 3, 144-6(May-June 1967). (In Russian).

An amplification stabilization system for a transistorized photomultiplier based on the reference light pulse from semiconductor light source is described. With photomultiplier amplification changes of 1.5 folds the pulse amplitude changes at the emission point do not exceed 7%. The system operates efficiently in the temperature range from +45 to −10°C. The system is supplied from a stable supply source; the general consumption is ±0.4v. (tr-auth)

45466 PHOTOMULTIPLIER DYNODE DELAYED EMISSION. Pertsev, A. N.; Soshin, L. D. (Belorussian State Univ., Minsk). Prib. Tekh. Eksp., No. 3, 147-50(May-June 1967). (In Russian).

Descriptions are given of the delayed electron emission from photomultiplier dynodes following their bombardment by multiplying electron beam. Dynode bombardment by electron beams with energies of 100 to 200 eV increased the intensity of the exponential part of the photomultiplier noise amplitude distribution. (R.V.J.)

45467 PULSE RADIOLYSIS STUDIES USING NANOSECOND ELECTRON PULSES: OBSERVATION OF HYDRATED ELECTRONS. Hunt, John W.; Thomas, J. K. (Univ. of Toronto. Argonne National Lab., Ill.). Radiat. Res., 32: 149-63(Sept. 1967).

The design and testing of a pulse radiolysis system with a resolving time of 2.5 nsec is described. This system utilized a 1P28 photomultiplier tube directly coupled to a sampling oscilloscope to attain a rise time of 2.5 nsec. Random shot noise was kept small by using an intense xenon light source, and photomultiplier fatigue was reduced by means of a rotating sector which reduced the average light intensity by 72 times. This system was used in conjunction with a 3-nsec 1.5-amp electron pulse from a 3-MeV Van de Graaff generator. The formation and decay of the solvated electron in water were critically examined. There was no evidence that a delay of greater than 0.5 nsec in the formation of e_{aq}^-, or that a significant fraction of the solvated electrons showed a nonhomogeneous "spur" type of decay in times longer than 0.5 nsec. (auth)

45468 AN ADJUSTMENT TO THE G5-7A GENERATOR FOR SPIN-ECHO SPECTROMETER. Novikov, L. N. (Ural Polytechnic Inst., Sverdlovsk, USSR). Prib. Tekh. Eksp., No. 3, 110-12(May-June 1967). (In Russian).

A simple adjustment circuit is described for the G5-7A generator for producing all basic rf pulse combinations in a spin-echo spectrometer. The circuit produces additional starting pulses with suitable parameters. The adjustment circuit is used for studying diffusion in optically-oriented spin systems and is capable of recording relaxation in the range from 2 to 20 μsec. (tr-auth)

45469 AN AFC SYSTEM USING A SUPERCONDUCTING RESONATOR. Mende, F. F.; Dmitriev, V. M.; Khristenko, E. V.; Churilov, G. E. (Kharkov Inst. of Low Temperature Physics and

Tech.). Prib. Tekh. Eksp., No. 3, 102-5(May-June 1967). (In Russian).

An AFC circuit is proposed which utilizes a superconducting resonator and a 3-cm reflex klystron. The circuit diagram of the AFC system is given. The superconducting resonator, made of C– O-type lead, had a loaded Q of $5 \cdot 10^6$ at a temperature of 4.2°K. The adjustment time of the stabilization system was equal to the time of transient processes in the intermediate-frequency amplifier, whose transmission band was 3 MHz. The stabilization coefficient was $1.2 \cdot 10^5$. (auth)

45470 CASCADE TRANSISTOR PULSE GENERATOR. Chechetenko, V. F. (Inst. of Physics and Tech., Kharkov). Prib. Tekh. Eksp., No. 3, 198-9(May-June 1967). (In Russian).

The basic design is given of a pulse train generator with duty-cycle frequency up to 165 MHz using P401 to P403, P410, and P411 Avalanche transistors. (tr-auth)

45471 REACTOR INTERCHANNEL CRYOSTAT WITH REMOTE COOLING SYSTEM. Andronikashvili, E. L.; Vadachkoriya, L. A.; Zamtaradze, L. A. (Inst. of Physics, Tbilisi, USSR). Prib. Tekh. Eksp., No. 3, 211-12(May-June 1967). (In Russian).

The design and performance of a cryostat for intrachannel cooling of a thermal neutron beryllium filter are discussed. The filter is cooled by liquid argon passing through a copper heat conductor. The beryllium filter with a collimator behind it was installed in a channel near the reactor core; the argon was placed in a radioprotective zone. The device was capable of reducing the losses of incident neutron flux intensity to a minimum. (tr-auth)

45472 THERMAL GRADIENT APPARATUS FOR USE IN A GLOVEBOX. Fischer, D. F.; Chasanov, M. G. (Argonne National Lab., Ill.). Rev. Sci. Instrum., 38: 1574-5(Nov. 1967).

A thermal gradient apparatus for use in a plutonium glovebox is described. Axial gradients of 1000°C/cm were maintained in oxide samples for continuous periods of time in excess of 500 hours with this furnace. The system is operable in inert atmospheres or high vacuum. (auth)

45473 POSSIBLE IMPROVEMENTS OF THE SENSITIVITY AND ACCURACY OF MASS SPECTROMETER MEASUREMENTS. Chalov, P. I.; Mamyrov, U. (Inst. of Physics and Mathematics, Frunze, USSR). Prib. Tekh. Eksp., No. 3, 123-5(May-June 1967). (In Russian).

Methods for improving the precision of mass spectrometer recording are discussed. Descriptions are given of the spectrum recording method enabling precision limited only by ion number statistics recorded for the mass of a selected range of a spectrum. The design of a device for spectrum time scanning in a mass spectrometer and synchronous control for a multichannel pulse-height analyzer is given as well as a mercury mass spectra. (R.V.J.)

45474 STUDIES OF FEU 63 PHOTOMULTIPLIER. Kulinich, Yu. A.; Rukavishnikov, V. G.; Shuvalov, R. S. Prib. Tekh. Eksp., No. 3, 141-4(May-June 1967). (In Russian).

The pulse-amplitudes of photomultiplier currents and the time-of-flight straggling of photoelectrons in the inlet chamber were measured as functions of the radial distance of the luminescence point for three photomultipliers. It is shown that an efficient supply cycle improved considerably amplitude characteristics and that the delay of electron collection time on the first dynode, at the luminescence point distance from the photo cathode center of 45 mm, can be reduced to 1 nsec. (tr-auth)

45475 CERAMIC MICROWAVE WINDOW FOR 8, 4, AND 2 MILLIMETERS. Day, Walter R. (Princeton Univ., N. J.). Contract AT(30-1)-1238. Rev. Sci. Instrum., 38: 1677-8(Nov. 1967).

The design and performance of a ceramic microwave window developed for microwave plasma diagnostic systems at eight, four, and two millimeters are discussed. The voltage standing wave ratio of the window vs frequency is presented at eight, four, and two millimeters. (W.H.K.)

45476 CONTINUOUSLY RECORDING STRAIN GAUGE THERMOBALANCE. Latta, R. E.; Bittel, J. T.; Hadesty, G. B. (General Electric Co., Cincinnati). Rev. Sci. Instrum., 38: 1667-9 (Nov. 1967).

A continuously-recording weight measuring device using strain gages as weight change sensors, which was developed for use in controlled atmospheres at temperatures up to 2800°C, is described. Both resistive-type strain gages and semiconductor strain gages are used. Drift of the strain gage is investigated. (W.H.K.)

45477 VACUUM MICROBALANCE FOR 77.3°K OPERATION. Whitefield, R. J.; Brady, J. J. (Oregon State Univ., Corvallis). Rev. Sci. Instrum., 38: 1670-1(Nov. 1967).

The design and performance of a quartz-oscillator microbalance for use at 77.3°K and 10^{-10} torr is presented. Temperature stabilization, mounting, operation, and oscillation stability are discussed. (W.H.K.)

45478 SENSITIVE 4 mm LECHER WIRE INTERFEROMETER FOR ELECTRON CONCENTRATION MEASUREMENTS IN LOW-DENSITY PLASMAS. Polman, J. (Philips Research Labs., Eindhoven, Netherlands). Rev. Sci. Instrum., 38: 1631-3(Nov. 1967).

A 4 mm microwave interferometer was developed for measurements on electron concentrations in low-density plasmas ($n_e \geq 10^{10}$ cm^{-3}). The microwaves are transmitted via Lecher wires, inserted across the discharge tube, to obtain high spatial resolution ($\lesssim$ one wavelength). The sensitivity of the system is improved by eliminating the influence of possible variations in the klystron frequency. A microwave phase shift as low as $2\pi \times 10^{-3}$ rad can be detected in this way. Density oscillations can be scanned by means of a sampling technique. An example of applications on low-pressure arc discharges is given. (auth)

45479 HIGH LEVEL NOR SPECTROMETER. Gill, D.; Hayek, M.; Alon, Y.; Simievic, A. (Hebrew Univ., Jerusalem). Rev. Sci. Instrum., 38: 1588-90(Nov. 1967).

A regenerative autodyne wired as a cathode biased grid-dip-meter is equal to Wang's spectrometer (Phys. Rev. 99: 566(1955)) in sensitivity and far superior in reliability. Detailed description of an autodyne used in chlorine NQR is presented. (auth)

45480 SOLID STATE GATED INTEGRATOR. Clark, W. Gilbert; Kerlin, A. L. (Univ. of California, Los Angeles). Rev. Sci. Instrum., 38: 1593-1604(Nov. 1967). (UCLA-34P121-6).

A simple, inexpensive, two-channel gated (boxcar) integrator circuit using solid state components is described. Features of the circuit include a wide range of usable gate widths (from 0.2 μsec to arbitrarily large), a wide range of learning times (0.05 μsec to 1 sec), a high ratio of holding to learning time (as high as 4×10^7 for 1% output voltage sag), linearity of about 0.3% over a range of ±8 V at the output, temperature stability of about 3.5 mV/C° at the output, and a long term drift of about 0.5 mV/h at the output. (auth)

45481 IMPROVEMENT OF THE DIFFERENTIAL LINEARITY OF A WEIGHTED CONVERTER. Hrisoho, A. (Institut de Physique Nucleaire, Orsay, France). Nucl. Instrum. Methods, 55: 344-8(Oct. 1967). (In French).

The considerable influence of the pulse stretcher on the differential linearity of a weighted converter is shown and discussed. Theoretical histograms are derived from the relationship between the channel-width and the stretcher slope. Finally, a circuit is described which carries out a new sequence of successive comparisons, entirely eliminating the influence of the stretcher on the differential linearity. Experimental spectra obtained through this method confirm the theoretical predictions. (auth)

45482 CONSTANT FRACTION OF PULSE HEIGHT TRIGGER FOR OPTIMUM TIME RESOLUTION. Gedcke, D. A.; McDonald, W. J. (Univ. of Alberta, Edmonton). Nucl. Instrum. Methods, 55: 377-80(Oct. 1967).

A fast discriminator which triggers at a constant fraction of the input signal amplitude is described. When operated by the anode current pulse from a photomultiplier tube the discriminator makes it possible to obtain optimum timing over a 100 : 1 dynamic range. In addition, the walk is within ±120 ps for this range. (auth)

45483 ACCURACY OF NUMERICAL SOLUTIONS FOR ELECTRON GUN DESIGN. Hamza, Vladimir (Bellcomm, Inc., Washington, D. C.); Kino, Gordon S. IEEE (Inst. Elec. Electron. Eng.) Trans. Electron. Devices, ED-14: 195-200(Apr. 1967).

Efforts to design electron guns by making use of a high-speed automatic digital computer are discussed, and it is pointed out that numerical analysis, with the aid of the high-speed automatic digital computer, is eminently suited to solving problems of this type. Several computer programs are available for the solution of the space-charge-flow problem for 2-dimensional and axially symmetric geometry. In these programs the basic process followed is specification of the potentials of the electrodes, initially assuming that the space-charge density is zero, and solution of Laplace's equation by finite difference methods to find the potential variation within the electrodes. The solution of Poisson's equation and the equation of motion by numerical methods is described. By consideration of the truncation error due to the use of difference equations in the one-dimensional case, it is shown, on the basis of a perturbation theory, that the error in the solution is proportional to the mesh size h. This theory is shown to be in good agreement with numerical solutions obtained on a computer. A correction formula is then derived which makes it possible, by obtaining solutions for two different mesh sizes h_a and h_b, to form a space-charge-flow solution accurate to second

order in h. It is also shown that more accurate forms of the difference equation may be obtained to represent the steady space-charge flow. By these various means, it is possible to increase the accuracy of numerical solutions by an order of magnitude or more. Thus, by using a coarse mesh, but better accuracy, the speed of computation may be considerably increased. (BBB)

45484 RETENTION POWER OF FIBER PAPER FILTERS FOR SMALL RADIOACTIVE IONS IN THE AIR. Bouville, Andre; Fontan, Jacques (Faculty of Science, Toulouse). J. Mec. Phys. Atmos., 6: 9-11(Jan.-Mar. 1964). (In French).

The efficiency of filtration of Schneider-Poelman fibrous filters was measured for Rn descendants created in the disintegration chambers of an apparatus used for measuring doses of radioactive gases. After collection, the activity of the control filter and the experimental filter was measured alternately with the same scintillation detector. Direct pumping of the aerosols from the air to the filters facilitated comparison. With the filters used, collection of ultrafine radioactive aerosols was more successful than that of atmospheric aerosols. Absorption by the filter was determined by α spectrometry. Absorption curves were established: the first for an electrostatic collector placed at the outlet of the disintegration chamber; the second, for the blue-type filter collecting aerosols formed in the disintegration chamber; the third for the red-type filter used to collect atmospheric aerosols during $\frac{1}{2}$ hr. Peaks of the curves showed that the aerosols were stopped in the surface layer of the filter. The electrostatic precipitator tested gave a resolving power of 8%, and that of the red filter 17% for atmospheric aerosols of RaC. The blue filter had a 13% resolving power for ultrafine aerosols, showing that collection was more superficial with this filter. It was concluded that, for aerosols of less than $\frac{1}{10}$ μ in size, filter paper is extremely effective because the aerosols are stopped by diffusion on the fibers. Furthermore it was inferred that active deposits of radon and thoron do not have to be fixed in the atmosphere on the larger aerosols to be filtered out and measured. (BBB)

45485 HELIUM COOLING COMPONENT FOR HIGH-RESOLUTION ELECTRON MICROSCOPY AND HOLLOW SUPERCONDUCTING CYLINDER AS A MAGNETIC LENS. Boersch, H.; Bostanjoglo, O.; Lischke, B. (Technische Univ., Berlin). Optik, 24: 460-5(1966-67). (In German).

With cooling of crystalline objects to low temperatures an increase in transmission of fast electrons occurs. A liquid He cooling stage was developed, for such electron optical investigations, which can be installed in the Siemens Elmiskop I. Temperatures of the specimen holder down to 2.8°K are produced for 15 min by lowering the vapor pressure, whereas 4.2°K is attainable for hours. The electron-microscopic resolution is limited by uncontrolled motion of the specimen due to thermal drift and the boiling of the liquid. Preliminary experiments yielded a resolution of 40 Å. The described cooling stage was used for investigations on hollow superconducting cylinders with trapped flux. Their electron optical properties were studied and a focal length of 3.3 mm at 40 keV was achieved. (BBB)

45486 FREQUENCY SPECTRUM GENERATORS AND THEIR APPLICATION. Holownia, Jan. Wroclaw, Wroclaw Polytechnic Inst., 1964. (In Polish).

Thesis.

A brief monograph on special-purpose short pulse generators is presented. General theoretical foundations of the spectrum analysis of pulses and the technical properties required in selective receivers and voltmeters designed for cooperation with pulse generators are discussed. A method is presented of unsteady state spectrum analysis in electrical circuits. An analysis of systems forming pulses in spectrum frequency generators was carried out on this basis. The design and circuits of such systems are also discussed. The less well known applications of frequency spectrum generators with particular emphasis on anti-interference technology and electronic measurements are included. (B.G.D.)

45487 IMPROVEMENTS IN OR RELATING TO ELECTRICAL COMPARISON CIRCUITS. Cox, Raymond John; Fowler, Eliot Patrick; Harrison, Donald; Railton, Peter Lawrence (to United Kingdom Atomic Energy Authority). British Patent 1,087,293. Oct. 18, 1967. Filed Aug. 15, 1963.

The design of a reactor control system for neutron-flux measurements in the reactor is presented. The neutron-flux monitor, which triggers an upper- or lower-level shutdown system, is based on the comparison of signals from an ionization chamber and a thermocouple. (W.H.K.)

Radiation Effects on Instruments and Instrument Components

45488 (HMI-B-60) AENDERUNG DER ELEKTRISCHEN EIGENSCHAFTEN VON Si SOLARZELLEN DURCH NEUTRONEN BESTRAHLUNG. (Change of Electrical Properties of Si Solarcells by Neutron Irradiation). Reinicke, B.; Zander, K. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). July 1967. 40p. (In German). (BEW-8). Dep.

The influence of fast neutrons on p-n-Si-solarcells is discussed. For tungstenlight (T_V = 2854°K) it was investigated: current-voltage-characteristics, efficiency, short circuit current and open circuit voltage as function of the irradiation. By means of spectral photosensitivity one can calculate the quantum efficiency. To explain values greater than unit (<1.25) one has to assume the existence of electrical fields in the base region. The strength of this field is calculated by an improved diffusion model. The damage factor of the diffusion length is evaluated and compared with those of literature. (auth)

45489 (HMI-B-61) DIE SCHAEDIGUNG VON BIPOLAREN TRANSISTOREN DURCH BESTRAHLUNG MIT PROTONEN IM ENERGIEBEREICH 2,5-4,5 MeV UND ELEKTRONEN DER ENERGIE 1,5 MeV. (Radiation Damage of Bipolar Transistors by Protons (2,5 to 4,5 MeV) and by Electrons (1,5 MeV)). Spencker, A.; Schnell, G.; Wagemann, H.-G.; Meinhardt, O. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). July 1967. 35p. (In German). (BEW-9). Dep.

The influence of protons at 2.5 to 4.5 MeV and electrons at 1.5 MeV on bipolar transistors is investigated by means of four types of recombination currents, which exist in the base of a bipolar transistor. These different types are separated by analyzing $I_B = f(U_{EB})$ characteristics. Their influence on current gain is discussed by means of the Webster equation. Theoretical introduction and measuring techniques without and with ionizing radiation are described. The results show that unwanted types of recombination current are generated by irradiation especially for low current injections ($I_B = 10^{-9} = 10^{-6}$A) into the transistor. Semiconductor devices of different origin are compared. (auth)

45490 (N-67-25481) A STUDY OF THE EFFECT OF SPACE RADIATION ON SILICON INTEGRATED MICROCIRCUITS. VOLUME I. Final Report, June 29, 1965-August 31, 1966. (Battelle Memorial Inst., Columbus, Ohio). Contract NAS5-9630. 185p. (NASA-CR-83801). CFSTI.

A program was conducted to classify four classes of integrated circuits, digital micropower circuits, digital dielectrically isolated circuits, digital MOS circuits, and amplifier circuits, according to their electron radiation susceptibility. Results showed that the radiation resistance of the circuits is determined by the stability of gain of the transistor elements with respect to electron exposure and the tolerance of circuit design with respect to changes in gain. For surface sensitive circuits operated at low current and/or high impedance, surface damage can cause sufficient leakage currents and/or gain degradation to result in device failure. No excessive temporary changes occurred in unbiased samples during irradiation. Amplifiers and MOS digital circuitry were the most sensitive to radiation. Circuits which failed from surface damage showed less degradation for unbiased units than for biased units. However, circuits which had some damage due to bulk effects showed more degradation for nonenergized circuits than for energized circuits. (STAR)

45491 (N-67-25482) A STUDY OF THE EFFECT OF SPACE RADIATION ON SILICON INTEGRATED MICROCIRCUITS. VOLUME II. Final Report, June 29, 1965-August 31, 1966. (Battelle Memorial Inst., Columbus, Ohio). Contract NAS5-9630. 332p. (NASA-CR-83802). CFSTI.

Circuit schematics, testing conditions and procedures, and tested parameters are detailed for three amplifier circuits, two micropower circuits, three MOS circuits, and two dielectrically isolated circuits. These characterization plans are contained in the appendix of a study dealing with the effect of space radiation on silicon integrated microcircuits. Other appendixes in this volume report the monitoring and test configurations during irradiation, characterization and radiation monitoring data, and manufacturer's data on 702A and 710A. Printouts are included of the computer program used to tabulate the raw data as well as of the monitored data itself. (STAR)

45492 (UCID-15218) EVALUATION OF TRANSDUCER SYSTEMS USED IN IRRADIATING ENVIRONMENTS: PROJECT TEE. Koci, D. (California Univ., Livermore. Lawrence Radiation Lab.). June 15, 1965. Contract W-7405-eng-48. 15p. Dep. CFSTI.

Problems encountered with transducers mounted on or in materials in a radiation path of a nuclear device are investigated. Specifically, the ionization and charge generations of the radiation flux shorts transducer supply sources and also some of the excess charge appears as signals at the input ampli-

fiers. Transducer systems to minimize these errors were tested and evaluated and the results are presented. (W.H.K.)

45493 INDUSTRIAL TELEVISION AND NUCLEAR ENERGY. Grenon, Michel. Sci. Progr.-Nature, No. 3387, 258-62(July 1967). (In French).

Some of the most representative uses of closed circuit television in the nuclear industry are reviewed and the special techniques employed to negate the effect of high intensity radiation on the components are indicated. (J.S.R.)

45494 A STUDY ON THE EFFECTS OF ^{60}Co γ RADIATION ON STEAM-GROWN SiO_2 MOS STRUCTURES. Mattauch, Robert Joseph. Raleigh, N. C., North Carolina State Univ., 1967. 185p. Thesis.

MOS capacitors were fabricated on both p- and n-type silicon substrates which had been thermally oxidized in a steam atmosphere. Capacitance-bias voltage curves were obtained with a measuring frequency of 100 kHz for both type devices. Device curve shift along the bias voltage axis yielded data from which it was deduced that the oxide charge moved by a diffusion mechanism. That charge was found to be positive and have an activation energy very near that of sodium in fused silica. Exposure of the devices to a gamma ray flux from a ^{60}Co source had the effects of both shifting the device curves along the voltage axis and decreasing the slope of those curves. A surface state density determination technique was employed and it was learned that the exposure of 3.6×10^6 roentgens caused the density of charges located at the oxide-semiconductor interface to increase from 10^{11} $cm^{-2}eV^{-1}$ by an order of magnitude. It was learned from ^{60}Co irradiation and elevated temperature studies that the surface state density can be decreased to its initial value but the oxide charge density is permanently decreased from approximately 10^{12} cm^{-2} to approximately 5×10^{11} cm^{-2}. A model based upon the Compton effect in the oxide is presented to explain the noted oxide charge change. (Dissertation Abstr.)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Refer also to abstracts 45066, 45281, 45450, 45600, 45618, 45788, 45803, and 45834.

45495 (AD-629215) RADIATION DAMAGE IN MUSCLE MEMBRANES AND REGULATION OF CELL METABOLISM. Annual Technical Report No. 2 (Final Progress), January 1–December 31, 1965. Perez, Juan Carlos; Stewart, Peter (Buenos Aires Univ. (Argentina). Facultad de Ciencias Medicas). Contract DA-ARO-49-092-65-G71. 61p. CFSTI.

Studies of K and Cs ion effects on Na ion efflux and O_2 consumption in resting muscle cell and the action of trypsin and phospholipase C in the presence of Cs of K Ringer's solution on resting membrane potential are reported. Sodium efflux results were consistent with calculated differences in penetration rates of C and K ions. But O_2 consumption results were reversed from anticipated if considered a reflection of energy to drive the Na pump mechanism. Work was done on membrane depolarization by various agents and their interaction and reversibility characteristics. Acetylcholine (Ach), Ach-Cs depolarizes membrane approaching a value of 55 mV or approximately the threshold action potential of membrane. This may be reversed by displacement by washing with K-Ringer. It was prevented by d-tubocurarine but not eserine. Trypsin had a stronger effect on Cs than K treated membrane. Trypsin did not alter capacity of Ach to evoke depolarization but altered its reversibility when Cs was substituted for K. A model receptor system and allosteric action mechanisms are discussed. (auth) (TAB)

45496 (COO-1073-10) IMMUNOCHEMICAL STUDIES OF RADIATION-INDUCED DAMAGE TO BIOLOGICAL SYSTEMS. Final Report. Leone, Charles A. (Kansas Univ., Lawrence. Dept. of Zoology). June 30, 1967. Contract AT(11-1)-1073. 34p. Dep. CFSTI.

Progress is reported on immunological studies of radioinduced damage to biological systems. Data are presented from studies on the antigenic and autoantigenic properties of nuclei and microsomes and a study of DNAase from the blood of several mammalian species. A list is included of 22 publications that report the results of studies performed under this contract. (C.H.)

45497 (N-67-23267) THE ROLE OF NUCLEOTIDE METABOLISM IN THE REPAIR OF RADIATION INJURY. Semiannual Progress Report, October 1, 1966–April 1, 1967. (Arkansas Univ., Little Rock). 8p. (NASA-CR-83540). CFSTI.

Research in the role of nucleotide metabolism in the repair of radiation injury is summarized, including reports on the effect of ^{60}Co gamma radiation on respiration and ATP metabolism of L cells, the effect of ^{60}Co gamma radiation on nucleotide metabolism of L cells, a nonlinear method for fitting cell survival curves, the effect of ^{60}Co gamma radiation on ATP synthesis by L cells, and the effect of 2,4 dinitrophenol on ATP synthesis and postirradiation survival by L cells. (STAR)

45498 (NP-16874) CONTRIBUTION A L'ETUDE DE LA DECONTAMINATION DANS LE CAS D'UNE CONTAMINATION INTERNE PAR LE MERCURE RADIOACTIF CHEZ LE RAT. (Contribution to Study of Decontamination in the Case of Internal Contamination by Radioactive Mercury in the Rat). Glory, Jean-Pierre Napoleon (Grenoble Univ. (France)). 1965. 71p. (In French). Dep.

Thesis.

A comparative study was made of the efficiency of four chelating agents: dimercapto-1,2-propanol, ethylene diamenetetraacetic acid (EDTA), diethylenetriaminepentaacetic acid (DTPA), and β,β-dimethylcysteine, as internal decontaminating agents for radioactive Hg in rats. An increase in the total excretion of ^{203}Hg of 13.4% was obtained for EDTA and of 29.7% for DTPA. The compounds with SH groups were much more efficient than previous chelating agents. The dimercapto caused an increase in the total excretion of 38.8% and cysteine, an increase of 44.9%. For cysteine, at the end of eleven days, the total excretion reached 93.5% of the activity injected. The urine contained 45.4% of the Hg after treatment by the dimercapto and 48.5% for the cysteine. The autoradiographic study of the anatomic distribution of ^{203}Hg injected under the same conditions in sample rats and in rats treated with different chelating agents indicated that most of the radioactivity was concentrated within the first 24 hours in the liver and kidneys. Results seemed to indicate that the chelating agents activated the elimination of Hg retained by the renal tissue but that only the compounds with SH groups caused an accumulated excretion of hepatic Hg. The LD 50/30 of EDTA and DTPA were much higher than those of the S chelating agents. The cysteine was the most efficient and had a mean toxicity. (tr-auth)

45499 (NYO-3480-3) PHYSICAL AND BIOLOGICAL OCEANOGRAPHY OF A LUMINOUS BAY. Annual Progress Report, July 16, 1966–July 31, 1967. Seliger, H. H. (Johns Hopkins Univ., Baltimore, Md. McCollum-Pratt Inst.). Contract AT-(30-1)-3480. 18p. Dep. CFSTI.

Progress is reported on studies of biological and physical parameters of Oyster Bay, Jamaica, a luminous bay. Data are included from a study of the spatial and temporal distribution of plankton and bacteria in the Bay. Preliminary results are reported from measurements of primary productivity using both extracted chlorophyll assay and $^{14}CO_2$ uptake. (C.H.)

45500 (NYO-3799-1) ELECTRON SPIN RESONANCE STUDIES OF IRRADIATED PYRIMIDINES AND PURINES. Progress Report, January 1–December 31, 1967. Snipes, Wallace (Pennsylvania State Univ., University Park. Dept. of Biophysics). Sept. 1967. Contract AT(30-1)-3799. 2p. Dep. CFSTI.

An investigation of irradiated pyrimidine–purine co-crystal complex was made. The complex studied was that of 1-methylthymine and 9-methyladenine. It was found that the radicals formed in this complex do not represent a simple composite of those formed in the individual components. At 300°K radicals were preferentially formed on the 1-methylthymine moiety. The radical had greater conformational stability and resistance to heat decay when in the co-crystal complex than in the 1-methylthymine crystal structure. Dihydropyrimidines were found to be ideal for studying the fate of pyrimidine radicals on dissolution in water, since the pyrimidines absorb UV light strongly in the region near 260 mμ, the corresponding dihydroderivatives do not. The investigation also included the effects of γ-irradiation on aqueous thymine dimer solutions and measurements of free radical decay at various temperatures using ESR. The radicals in irradiated alloxan and 5-nitro-6-methyluracil were identified and the effects of radiation on cytidylic acid were studied. (D.H.M.)

45501 (ORAU-101, pp 12-13) TRIGLYCERIDE DEPOSITION IN IRRADIATED BONE MARROW. Snyder, Fred L.; Wood, Randall (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

The effects of 800 R γ radiation on fatty acid metabolism in the bone marrow of rats were studied. Palmitic acid labeled with ^{14}C was used as a tracer of triglyceride metabolism. Triglycerides were isolated by thin-layer chromatography. The maximal period for triglyceride synthesis was found to be between 3 and 4 days after whole-body irradiation. Newly formed triglyceride deposited in irradiated bone marrow had a higher carbon number than that in control animals. (C.H.)

45502 (ORAU-101, pp 103-5) THEORETICAL AND EXPERIMENTAL STUDIES ON RETENTION AND DISTRIBUTION OF RADIONUCLIDES. I. TURNOVER COMPARTMENTALIZATION. Bergner, Per-Erik E. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

Theoretical approaches and mathematical models that can be used to clarify the interpretation of data on the absorption, distribution, and excretion of tracer amounts of radioisotopes in the body of man are discussed. Methods for determining the whole-body content of various elements using tracer data obtained by whole-body counting are described. A modification of Marshall's method that considers compartmentalization in terms of turnover times or mean-transit times is described in which the difference between the homogeneous and nonhomogeneous system is quantitative rather than qualitative. (C.H.)

45503 (ORNL-4145, pp 243-59) BIOCHEMICAL SEPARATIONS. (Oak Ridge National Lab., Tenn.).

A reversed-phase chromatographic system was developed for macromolecular separations. Engineering-scale research and development provided information on scaled-up procedures for the preparation of purified tRNA's. Molecular weights of the transfer ribonucleic acids were determined along with their behavior on polyacrylamide gel columns. Automatic high-resolution analyzers capable of quantifying the molecular constituents of human body fluids are being developed. (M.C.G.)

45504 (ORNL-P-3324) EXCISION OF PYRIMIDINE DIMERS IN VIVO AND IN VITRO. Setlow, R. B.; Carrier, W. L. (Oak

Ridge National Lab., Tenn.). [1967]. Contract W-7405-eng-26. 18p. (CONF-670822-1). Dep. CFSTI.

From International Conference on Replication and Recombination of Genetic Material, Canberra, Australia.

The processes of excision of pyrimidine dimers in vivo and in vitro are summarized. Despite the fact that excision can effect the repair of up to 90% of the damage resulting from pyrimidine dimers, the details of the steps in, and associated with, excision are not known; nor is the order of the steps, if there is an unique order, understood. The excision mechanism was not confined to damages arising only from ultraviolet radiation. (auth)

45505 (TID-24056) PYRIMIDINE DIMERS IN THE DNA OF PARAMECIUM AURELIA. Sutherland, Betsy Middleton (Tennessee Univ. [Knoxville]). Dec. 1967. 92p. Dep. CFSTI.

Thesis.

Results are reported from a study of the production and subsequent fate of pyrimidine dimers induced by small doses of uv in the DNA of Paramecium aurelia. Results indicate that pyrimidine dimers are involved in the production of mutations in Paramecium. (137 references). (C.H.)

45506 (UCRL-17520) CHEMICAL BIODYNAMICS ANNUAL REPORT, 1966. (California Univ., Berkeley. Lawrence Radiation Lab.). May 1, 1967. Contract W-7405-eng-48. 94p. Dep. CFSTI.

Progress is reported on the following studies: paramagnetic hyperfine structure and relaxation effects in Moessbauer spectra of ^{57}Fe in ferrichrome A; chemical bonding information from photoelectron spectroscopy; Fourier transform nuclear magnetic resonance spectroscopy; optical properties of ribonucleic acids; biochemical studies on chlorophyll; use of ^{14}C in studies on photosynthesis by isolated chloroplasts; biosynthesis of opium and tobacco alkaloids; genetic control of catabolite repression; attempted modification of rat behavior by injection of brain extracts from trained donors; experimental complexity, cerebral change, and behavior; organic deposits from Mud Lake, Florida; and search for δ-aminolevulinic acid as a product of methane-ammonia-water irradiation. Separate abstracts were prepared on two papers. (H.L.W.)

For abstracts of individual sections see: 45147 and 45148.

45507 EFFECT OF UV IRRADIATED AND UNIRRADIATED CHLOROPRENE ON THE PROCESS OF OXIDATION OF IRON. Mkhitaryan, V. G.; Astvatsatryan, S. A. (Inst. of Medicine, USSR). Biol. Zh. Arm., 20: No. 5, 37-48(May 1967). (In Russian).

Chloroprene, added to sulfuric acid solutions (0.01M) of ferrous oxide, oxidized the di-valent iron into the tri-valent iron. Its effect depended both on the storage period of chloroprene after distillation at low temperature and on its quantity. Chloroprene in the first, second, and following days after distillation in quantities of 0.5 mM during 30 min of incubation increased the concentration of trivalent iron in comparison with the controls by 1.28, 1.4, and 2.1 times and at 60 min incubation, 2.35, 3.0, and 3.8 times. Chloroprene under all test conditions in quantities of 1.0 mM with 30 min incubation increased the concentration of tri-valent iron 1.4, 1.5, and 2.8 times and with 60 min incubation, 3.0, 3.6, and 10.5 times. On irradiation of chloroprene with uv light, its oxidizing properties significantly increased. On the first, second, and third day after distillation in quantities of 0.5 mM with 30 min incubation the Fe^{+++} concentration increased 2.35, 2.8, and 5.5 times and with 60 min incubation, 2.5, 4.2, and 11.5 times. In the presence of antioxidants or reductants, the oxidation process of iron by chloroprene was depressed. (tr-auth)

45508 ANTIBODY FORMATION AND CHANGES OF SERUM PROTEIN UNDER THE INFLUENCE OF WHOLE-BODY LOW-INTENSITY X-IRRADIATION. PART I. Schmidt, W.; von Maltzahn, D.; Friemel, H. (Univ., Rostock, Ger.). Radiobiol. Radiother., 8: 387-99(1967). (In German).

Under the chosen experimental conditions, low, whole-body x-ray doses favored the formation of immune antibodies. Fifteen days after immunization this proliferative stimulus was especially clear. After eight days there was no significant difference between those animals that were exposed to 10 and 50 R and the unexposed but immunized animals. After 22 days the applied radiation stimulus seemed to have worn off. There was no irreversibly damaging depressive effect on the system forming the antibody. Only eight days after exposure to 10 R and immunization, a certain restriction of antibody formation was absent when 50 R (≈ 20 RL) was administered. An explanation of this phenomenon cannot be given at the present time. Probably, a higher number of animals was needed. An accumulation of especially sensitively reacting rats in this irradiation series could be possible. (auth)

45509 EFFECT OF RADIUM TREATMENT ON ACTIVITY AND DISTRIBUTION OF SOME ENZYMES IN CANCERS OF THE HUMAN CERVIX UTERI. Goldberg, David M.; Ayre, Heather A.; Pitts, Janet F. (Western Infirmary, Glasgow). Cancer, 20: 1388-94(Sept. 1967).

The activities and distribution of nucleases, adenosine deaminase and dehydrogenases of lactate (LDH), isocitrate and phosphogluconate were examined in tissue biopsies obtained from 16 patients with carcinoma of the cervix uteri before and after therapeutic radium treatment and fractionation into mitochondrial, microsomal and supernatant preparations. A significant increase in the specific activities of alkaline and acid ribonuclease occurred in all three cytoplasmic fractions after radium treatment and a significant fall in LDH specific activity took place in the supernatant fraction. The specific activities of the other enzymes were unaffected or moderately reduced. Radiation did not alter the protein content of the mitochondrial and microsomal fractions relative to tissue weight but the protein content of the supernatant was halved, leading to significant reduction in the activities of several enzymes relative to tissue weight. This work has revealed early biochemical changes induced by radium treatment with potential application to radiotherapeutic assessment. (auth)

45510 THE TECHNIQUE OF STUDYING ^{32}P INCLUSION INTO BLOOD ERYTHROCYTES. Utekhin, E. V. Med. Radiol., 12: No. 7, 81-2(July 1967). (In Russian).

A technique is described for investigating ^{32}P inclusion in blood erythrocytes, which enables the determination of the quantity of absorbed ^{32}P. (auth)

45511 BIOLOGICAL BEHAVIOR OF RABBIT ^{131}I-ALBUMIN POLYMERS. Bocci, Velio (Univ. of Siena, Italy). Arch. Biochem. Biophys., 120: 621-7(June 1967).

Electrophoretically separated rabbit serum albumin is essentially in a monomeric form, whereas old freeze-dried albumin or fresh albumin oxidized by chloramine T, at pH 5.1, shows a number of polymers. The monomer, the dimer, the trimer, the tetramer, and the polymers of old freeze-dried rabbit serum ^{131}I-albumin were separated by gel filtration of Sephadex G-200 and, by determining the relative specific activities, a decrease of radioactivity was shown in the polymeric albumin. The albumin components were characterized by agar and starch gel electrophoresis and by double diffusion in agar gel in order to ascertain the purity and the identity with the monomeric albumin. Having excluded depolymerization of ^{131}I-albumin aggregates in vivo, the biological behavior of rabbit ^{131}I-albumin, either in monomeric or in polymeric form, was examined. The results indicate a progressively shorter half-life and an increase in the eliminated radioactivity as the degree of polymerization increases. (auth)

45512 INVESTIGATION OF METABOLIC PROCESSES WITH RADIOISOTOPES. Leng, R. A.; West, C. E. (Univ. of New England, Armidale, Australia). Isotop. Radiat. Technol., 4: 186-8(Winter 1966-1967).

The rate of production of certain biochemical compounds used by sheep in oxidative catabolism and the contribution of these compounds to the energy expenditure of the animal under normal and fasting conditions have been estimated by using radioisotope dilution techniques and carbon-14-labeled substrates. (auth)

45513 REGENERATION OF LIVER AS A MODEL OF RADIOSENSITIVE TISSUE SYNCHRONIZED WITH THE GENERATIVE CYCLE. Zicha, B.; Dienstbier, Z. (Charles Univ., Prague). Cesk. Fysiol., 14: 460-78(1965). (In Czech).

Radiation effects on DNA synthesis and enzyme systems in regenerating liver are reviewed. One hundred seventy two references are cited. (H.L.W.)

45514 BIOCHEMICAL EFFECTS (DNA, RNA, AND PROTEIN). pp 485-545 of The Radiobiology of Cultured Mammalian Cells. Elkind, Mortimer M.; Whitmore, Gordon F. New York, Gordon and Breach Science Publishers, 1967.

Experiments dealing with the effects of radiation on DNA, RNA, and protein syntheses in mammalian cells are described. The authors conclude on the basis of available data that DNA synthesis while in progress can be temporarily impaired by radiation. The passage of cells through all phases of the DNA synthetic cycle is slowed down. This effect is most evident in the period between DNA synthesis and mitosis (G2). The nature of the lesion in DNA synthesis is unknown; part of the effect may be in the enzymes involved. Enzymes in general are relatively unaffected by irradiation of the cell, although certain systems have been shown to be markedly affected such as the activity of kinase and polymerase in regenerating rat livers. RNA synthesis mechanisms appear to be less radiosensitive than those for DNA synthesis. 116 references. (M.M.B.)

45515 INFLUENCE OF LACTOSE AND GLUCOSE ON ^{28}Mg RETENTION IN THE CHICK. Scholz, R. W.; Featherston, W. R. (Purdue Univ., Lafayette, Ind.). J. Nutr., 91: 231-6(Feb. 1967).

The utilization of orally or intraperitoneally administered ^{28}Mg was studied in chicks fed diets containing 300 ppM Mg and either glucose or lactose (25% of diet) plus glucose as carbohydrate sources. No significant influence of the dietary carbohydrate was observed on the retention of orally or intraperitoneally administered ^{28}Mg in the whole chick. Radioactivity in the blood at the initial withdrawal and in the femur at the termination of the experiments, however, indicated an increased concentration of ^{28}Mg in these tissues for chicks fed lactose in their diets. These differences were statistically significant only for chicks receiving ^{28}Mg by oral administration. Radioactivity in the blood and femur of chicks given intraperitoneal injections of ^{28}Mg was not significantly altered by the source of carbohydrate, although these values were higher for birds fed lactose in their diets. Lactose, in addition to its influence on increased feed consumption and hemoconcentration which were previously reported, appears also to exert a stimulatory influence on ^{28}Mg absorption in the chick. (BBB)

45516 EFFECT OF SEVERAL LEVELS OF CARRIER IODINE ON ^{131}I RETENTION BY CALVES. Barth, K. M. (Univ. of Tennessee, Knoxville); Kessler, W. V.; Plumlee, M. P.; Christian, J. E. J. Anim. Sci., 26: 651-3(May 1967).

The effect of various levels of stable iodine, fed 12 days before and after ^{131}I administration, on whole-body retention of a single dose of ^{131}I in calves was studied. The 50, 500, or 1000 mg stable iodine per day (as KI) was added to reconstituted milk just prior to feeding. Whole-body radioactivity was measured in the scintillation detector before ^{131}I administration, on the day of radioiodine dosing, and on days four, seven, and eleven thereafter. The percentage body retention of radioactivity in the calves four, seven, and eleven days after ^{131}I administration is shown. During all counting periods, the percentage ^{131}I body retention decreased as the level of stable iodine feeding was increased. However, these differences were not always statistically significant. Four and seven days after ^{131}I dosing, there was a relatively constant relation between amount of stable iodine fed and body retention as percentage of control, within the limits of this experiment. As the trial progressed, this relation became increasingly curvilinear; a smaller percentage decrease of ^{131}I retention per additional unit of stable iodine fed was observed. Therefore, the beneficial effect of the higher levels of stable iodine administration was more pronounced at the beginning of the experiment than at the end. (BBB)

45517 INCIDENT LIGHT PHOTOMETRIC STUDIES ON THE MAGNITUDE OF COINCIDENCE IN AUTORADIOGRAPHY WITH TRITIUM. Doermer, P. (EURATOM, Munich). Histochemie, 8: 1-8(1967). (In German).

Theoretical and practical aspects of measuring ^{3}H in tissue sections are discussed. On the basis of tests with graduated light densities on stripping film preparations, it was shown that a quantitative determination (up to ~70 silver grains/10 μ^2) of the silver grains was possible by incident light microscopy. The proportion of the number of silver grains present to the number of silver grains to be expected in relation to the exposure time was determined on the basal cells of the stomach in mice after the administration of ^{3}H-thymidine. The result was expressed as a coincidence coefficient that depended on the silver grain density. It was pointed out that in cases of a high silver grain density and in certain quantitative autoradiographic problems the coincidence of β particles has to be taken into consideration. (BBB)

45518 A TECHNIQUE FOR CONTINUOUS SIMULTANEOUS DETECTION OF TWO INDICATORS IN THE CIRCULATION. Maseri, Attilio; Enson, Yale (Columbia Univ., New York). J. Appl. Physiol., 22: 153-7(Jan. 1967).

A technique for the continuous simultaneous detection of a dye and a γ-emitting radioactive tracer sampled from some portion of the circulation is presented. A flow-through scintillation probe and densitometer were connected in series in this order with respect to the sampling catheter. In vitro studies showed that when an impulsive function, identical for the two indicators, was imposed at the distal tip of the catheter, the time-concentration curve of dye was only slightly more dispersed than that of the γ-emitting tracer (0.08 sec) when the sampling rate was one ml/sec. At a sampling rate of two ml/sec or of 2.5 ml/sec the two time-concentration curves, once normalized, were superimposable when their origins were made to coincide. In vivo experiments confirmed these findings. Therefore, when sampling from some section of the circulation, once the dye curve has been shifted back by a time equal to the transit time between the two detecting devices, the two curves, normalized, can be compared directly. Any variation between these replotted curves would then be due to differences between the input functions at the tip of the sampling catheter. (BBB)

45519 DYNAMICS OF BLOOD SERUM LIPIDS IN PATIENTS SUFFERING FROM DIFFUSE TOXIC GOITER DURING RADIOIODINE TREATMENT. Slukhai, Yu. F. Med. Radiol., 12: No. 5, 67-9(May 1967). (In Russian).

Changes in the lecithin, cholesterol and total β-lipoprotein content of the blood of diffuse toxic-goiter patients, treated with ^{131}I were determined from data on the lecithin/total cholesterol fraction and the β-lipid index. It was found that the blood had a lower lecithin and cholesterol level than that of the control group. The level of cholesterol was strongly lowered, resulting in an increase of the lecithin/cholesterol ratio. The patients received a single treatment of ^{131}I and were then kept under observation for one year. No changes were noted in the lecithin and cholesterol level for three to five weeks after the treatment, but the β lipoprotein content increased somewhat during this period. Within three months, euthyroid condition was noted in all patients, and the level of blood lipids became normal. Examination after six months revealed a slight decrease in the level of all lipids; this was probably due to the recovery of the injured thyroid cells. After one year, the increase in the cholesterol content resulted in a decrease in the lecithin/cholesterol ratio. The lipid level thus exhibited fluctuations; this was attributed to the slowing down of the functional activity of the thyroid gland followed by regeneration of the injured tissue. Determination of lipid metabolism may be used as a diagnostic test for the state of the thyroid gland. (TTT)

45520 STUDIES ON THE ^{131}I THYROIDAL UPTAKE CURVE IN HUMAN SUBJECTS. Nakamura, Yoshihumi (Tottori Univ., Yonago, Japan). Yonago Igaku Zasshi, 16: 580-92(Dec. 1965). (In Japanese).

Studies were made on the ^{131}I-thyroidal uptake curves for healthy persons and patients with various thyroid diseases, and on the effects of inorganic iodine, antithyroid drugs and thyroid stimulating hormone (TSH). The results obtained are as follows: (1) The ^{131}I uptake of 47 healthy persons was 6.3% on an average after 3 hours, and 11.7% after 24 hours. The early descending type of ^{131}I uptake (in which ^{131}I uptake becomes lower than 80% of its highest value after 24 hours) was observed only in one case. When 8 to 9 mg of KI was added to ^{131}I as a carrier, ^{131}I uptake decreased and the early descending type occurred in one third of the whole cases. When 200 to 400 mg of KI was added, all showed the early descending type. (2) The early descending type was observed in about one third of the cases of untreated hyperthyroidism, in half of hypothyroidism, of hypothyroid dwarfism, and of hyperthyroidism being treated by antithyroid drugs. (3) By TSH injection, ^{131}I uptake was increased in persons with normal thyroid function, but it was rather decreased in most of the hyperthyroidism cases. Concerning the type of ^{131}I uptake, TSH administration converted about 8% of the normal type into the early descending type, but 53% of the early descending type remained the same after the administration. (4) The TSH's early effect that its releasing effect appears more rapidly than its uptake promoting effect, was studied. This effect was not apparent in the external measurement of ^{131}I 3 to 6 hours after TSH administration, but was clearly observed by the measurement of ^{131}I and $PB^{131}I$ in plasma. That is to say, in persons with normal thyroid function, the release of $PB^{131}I$ into plasma is increased and inorganic ^{131}I in plasma decreases, resulting in a decrease of total ^{131}I in plasma. In hyperthyroidism, however, the release of both $PB^{131}I$ and inorganic ^{131}I into plasma are increased. (NSAJ)

45521 KARYOMETRIC STUDIES ON THE RADIATION EFFECT ON INTERNAL ORGANS AT DIFFERENT ENERGIES. Almendral, Alfonso Castano (Univ., Goettingen, Ger.). Strahlentherapie, Sonderbaende, 64: 185-90(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18-21, 1966. See CONF-660566.

Radioinduced variations in nuclear diameter are dependent on dose, time, and quality of the radiation. The ratio between the number of pathologic nuclei, nuclei with a diameter greater than four log 0.768 (mean value of the nuclei of the control animals), after ^{60}Co γ irradiation and after x irradiation showed a relative biological effectiveness of 0.92. It appears noteworthy that the urethra, after a single irradiation with doses up to 6,000 R, showed no important aberrations of function during the observation interval. (tr-auth)

45522 ACTION OF ULTRA-VIOLET LIGHT ON SOLUBLE COLLAGENS. Consden, R.; Kirrane, J. A. (Medical Research Council, Taplow, Eng.). Nature (London), 215: 165-6(July 8, 1967).

It has been found that the material of rat tail tendon becomes

less soluble after exposure to short wave UV light, and that the amount of soluble collagen in mouse skin was similarly decreased. It has also been found that irradiation of acetic acid solutions of calf skin collagen resulted in an ability to fluoresce in long wave UV light. These changes in properties have been ascribed to formation of crosslinks from the aromatic side-chains of phenylalanine and tyrosine. The present authors, working with suspensions of acid-soluble and neutral salt-soluble collagens from rat skin, found that short wave UV light produces fluorescence, and attempted to measure the fluorescence quantitatively and correlate with solubility and shrinkage temperature changes after different periods of irradiation. Experimental details are described. Effects were noticeable after only short exposures. They were consistent with the formation of new crosslinks and increased H-bonding. It was found that prolonged irradiation of acid-soluble collagen suspension resulted in a slight fall in fluorescence, which would be consistent with the breakage of bonds by UV light of sufficient energy. (UK)

45523 MECHANISM FOR THE EXCHANGE OF THE CALCIUM IN BONE MINERAL. Samachson, J. (Veterans Administration Hospital, Hines, Ill.). Nature (London), 216: 193-4(Oct. 14, 1967).

It is stated that little attention has been paid to the actual process of exchange of Ca in bone mineral, that is, the chemical reaction by which the Ca on the surface is replaced by radioactive calcium (or other elements). Bone mineral, considered to be chiefly hydroxyapatite, is markedly impure, particularly as regards its surface. For this, and other reasons, it is extremely improbable that the surfaces of bone mineral crystals have the same structure as the interior, and also that there is any sharp distinction on the surface between screw axis or columnar Ca ions of bone mineral or hydroxyapatite. It is suggested that addition of a Ca ion to the surface of bone mineral, rather than the expulsion of a previously bound Ca ion, is the first step in exchange. A radioactive ion from surrounding fluid would have much more chance of forming a bond with a O-atom, which is always accessible, than of striking a vacant Ca site. Most of the bonds formed are unstable and immediately break up, but a small proportion may remain until the neighbouring Ca ion is ejected. The new ion slips down to occupy the more stable position available to it. This sequence of events is in accordance with knowledge of crystal behavior, and is supported by evidence obtained with ^{65}Zn. Studies with the latter are described. Zinc-65, used without carrier, reacts more rapidly and to a greater extent with bone material than do ^{47}Ca, ^{85}Sr, and ^{133}Ba. This is in contrast to the effect of Ca in reducing uptake of ^{85}Sr and ^{133}Ba tracer. More rapid uptake of ^{65}Zn than of ^{47}Ca would not be expected if the rate determining step were removal of a Ca ion, but would be expected for addition of a ^{65}Zn ion. The formation of zinc phosphate appears to be ruled out. (UK)

45524 NEUTRON ACTIVATION AS A MEANS OF DETECTING PHOSPHORYL PEPTIDES. Shaw, D. C. (Australian National Univ., Canberra). Nature (London), 215: 410-11(July 22, 1967).

Amino-acid sequences about "active-center" residues, which react with organo-phosphorus inhibitors or which are the site of attachment of phosphate in phosphoryl-enzyme intermediates, are a subject of interest. In previous studies ^{32}P labeling has generally been used and the peptides, after degradation of the protein, are detected and distinguished from other ninhydrin-positive material by their radioactivity. The present communication reports a new procedure in which the protein is reacted with unlabeled reagent, the phosphorylated protein hydrolysed, the peptides separated by electrophoresis and then subjected to neutron irradiation on paper, whereby the P is made radioactive and can be detected by autoradiography or scanning techniques. This procedure avoids working with radioactive reagent. In the studies described chymotrypsin and subtilisin, inhibited with DFP (di-isopropylphosphoryl fluoridate) to yield the DIP (di-isopropylphosphoryl)-enzymes, were used, together with the natural phosphoryl protein pepsin. The patterns of phosphoryl peptides obtained were the same as observed in earlier studies and characteristic of the sequences Gly. Asp. Ser DIP. Gly and Thr. Ser DIP. Met. Ala. The procedure could be applied to an enzyme hydrolysate of a suspected phosphoryl-enzyme intermediate isolated from an enzyme catalysed reaction. Study of such peptides would enable determination of the stability of the phosphoryl bond. The use of neutron activation in the characterization of small quantities of nucleic acids has also been reported. (UK)

45525 RADIATED HOMOGENOUS CARTILAGE IN RHINOPLASTY. Marquit, Bela (Columbia Univ., New York). Arch. Otolaryngol., 85: 78-80(Jan. 1967).

Techniques for megavoltage electron irradiation of human cartilage for use in plastic surgery of the nose are reported. In the past, homologous cartilage, procured and preserved by various methods, was rejected in most cases. The problem was in the elimination of the antigenetic factors causing these graft rejections, and it was solved by the use of irradiated homografts because tissue treated in this fashion does not provoke antigenic reactions. Although high-energy electrons can sterilize all biological material adequately, they have one technical disadvantage. Their penetration is limited to ~1.5 cm. However, this limitation presented no problem since there was no need for grafts thicker than 1.5 cm. The length and width could vary without limit. The irradiated tissue was stored at freezing temperatures. Such preserved cartilage was used for the repair of saddle deformities of the nose, depressed defects of the malar and frontal regions, and in the orbit, chin, and larynx. The wound infection rate was about 0.9%. In preparing specimens from cadavers, excess connective tissue was removed from the cartilage. The grafts were packaged in plastic and subjected to β radiation by the 3-MeV machine that delivered 2 Mrep over 10 sec. The conveyor belt was enclosed during this procedure, and the internal temperature was maintained at −78°C. During the preparation and packaging of the cartilage grafts, small samples were taken for bacteriologic cultures. Grafts were released for use only after a negative culture was obtained on the specimens. Before use, the graft was placed in benzalkonium chloride (Zephiran) solution. This served the double purpose of sterilizing the outer bag and thawing it. In one instance histologic studies were made of irradiated cartilage eight months after it had been implanted in a patient. Sections of the cartilage showed that the cells were stainable and the nuclei intact. There was no evidence of acute or chronic inflammatory degeneration. The cartilage appeared no different from cartilage that was not irradiated or grafted. (BBB)

45526 FURTHER STUDIES ON THE INFLUENCE OF STORAGE AND X RAYS ON THE FIBRINOLYTIC ACTIVITY OF STREPTOKINASE–STREPTODORNASE IN VITRO. Szirmai, E. (Technische Hochschule, Stuttgart); Berkarda, B.; Akokan, G. Arzneim.-Forsch., 17: 50-5(Jan. 1967). (In German).

The effect of prolonged storage and of x rays and ^{60}Co γ rays on the enzyme activities of Varidase was studied. Storage up to two yrs after the date of expiration as indicated by the manufacturer had no influence on the activity of substances that activate fibrinolysin in vitro, that is streptokinase + streptodornase (SK + SD). Irradiation with x rays at a dose of 1200 R had no significant effect on the activity of profibrinolysin (SK + SD). After irradiation the anticoagulation activity and the profibrinolytic effects of the SK + SD preparation were unchanged in the coagulation systems studied. (BBB)

45527 INTERACTIONS BETWEEN RADIATION AND MATTER. Tubiana, M. (Institut Gustave-Roussy, Villejuif, France). pp 17-84 of Radiobiologie Appliquee. Tome I. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

The elementary interactions between photons and matter and the interaction of photon beams are outlined. Elementary interactions between electrons and matter are described. The energy transfer to the medium and the secondary electrons to a photon beam are considered. In the area of dosimetry, the concepts, magnitudes, and units are first defined. The measurement methods and the practical problems of instrumentation are given. The energy absorbed in the medium is discussed with respect to the dose distribution, the dose at the interface, and the spatial distribution of the energy absorbed. (J.S.R.)

45528 SOURCES OF RADIATION. Wambersie, A.; Dutreix, A. (Institut Gustave-Roussy, Villejuif, France). pp 85-162 of Radiobiologie Appliquee. Tome I. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

The principles of operation of the principal types of devices generating x radiation, gamma radiation, electrons, accelerated particles, and neutrons are given. The performances to be expected from the various devices and the interaction of the various beams with matter are considered. Some particular irradiation techniques are cited. (J.S.R.)

45529 PARAMAGNETIC RESONANCE IN RADIOBIOLOGY. Duquesne, M. (Institut du Radium, Paris). pp 163-98 of Radiobiologie Appliquee. Tome I. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

The physical elements on which paramagnetic resonance is based are given and the principal applications of this technique in radiobiology are indicated. The magnetic properties of atoms and molecules are described. The principles of paramagnetic resonance are outlined in some detail. The use of electron paramagnetic resonance in radiobiology is illustrated by a consideration of radiobiology and free radicals, method of study and ex-

perimental apparatus for the resonance of the electron spin, analysis of resonance signals, and biological applications. (J.S.R.)

45530 CHEMICAL ACTION OF RADIATIONS. INDIRECT EFFECT ON BIOLOGICAL SYSTEMS. Lefort, Marc (Faculte des Sciences, Paris). pp 263-94 of Radiobiologie Appliquee. Tome I. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

The absorption of ionizing radiation by water molecules, followed by the formation of hydroxyl radicals, solvated electrons, atomic hydrogen, and hydrogen peroxide from these water molecules is described. The redox phenomena caused by these radicals and other species acting on the simple dissolved bodies such as mineral salts are discussed. The indirect action on the simple organic compounds is outlined. Some ideas are given on the more complex processes which seemingly can be explained by the action of these free radicals on the substances of biological interest. (J.S.R.)

45531 EFFECTS OF IONIZING RADIATIONS ON NUCLEIC ACIDS. Ekert, Bernard (Fondation Curie, Paris). pp 295-358 of Radiobiologie Appliquee. Tome I. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

The totality of the modifications induced by radiation in nucleic acids is described. The radiochemical transformations of the basic constituents of nucleic acids, i.e. the action of radiation on the primary structure of these macromolecules, are first studied. The modifications of the secondary structure, the immediate consequence of the alteration of the primary structure, are then considered. The effect of radiations on the biological activity of nucleic acids in vitro in well-defined enzymatic systems, responsible particularly for the biosynthesis of proteins, is studied. (J.S.R.)

45532 BIOLOGICAL ASPECTS OF WHOLE-BODY IRRADIATION. Mandel, P.; Rodesch, J (Faculte de Medecine, Strasbourg). pp 359-418 of Radiobiologie Appliquee. Tome I. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

The specific action of whole-body irradiation was analyzed systematically. The secondary reactions due to the response of the organism in its entirety were not considered. In sequence the following compounds and their metabolism after irradiation were studied: water and electrolytes, carbohydrates, lipids, proteins, and nucleic acids. 336 references. (J.S.R.)

45533 EXPERIMENTATION WITH RADIOISOTOPES. Daudel, P. (Institut du Radium, Paris). pp 955-1005 of Radiobiologie Appliquee. Tome II. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

The techniques used in the radiotracer method are briefly outlined, giving the preparation of radioelements, synthesis of labeled molecules, and radiation detection methods. Some applications of radiotracer methods (analysis of sugars produced by photosynthesis, analysis by isotopic dilution, double labeling, effect of x rays on metabolism of phospholipids and on incorporation of glycine in proteins, effect of UV on the role of Poly U in the synthesis of polypeptides, effects of x rays on metabolism of nucleic acids, and study of the protective effect of sodium cyanide in the rat) were described. (J.S.R.)

45534 MICRO-SURGERY BY IRRADIATION OF CELLULAR ORGANELLES (ULTRAVIOLET RAYS AND LASER). Bessis, M. (Centre de Transfusion Sanguine, Paris). pp 669-94 of Radiobiologie Appliquee. Tome II. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

The principle and use of ultraviolet and laser microbeams as instruments of microsurgery for the study of cellular functions are described. The techniques used for the evaluation of the results include optical microscopic study of the alterations following micropuncture, electron microscopic study, metabolic effects on the cell, and effect of the cellular alterations on the environment. The principal results obtained on the irradiation of the nucleus at rest, irradiation of the nucleolus, irradiation of the mitotic apparatus, irradiation of the cytoplasm, different types of cellular death, and effect of the death of one cell on the environment are reported. (J.S.R.)

45535 ISOTOPE-EXAMINATION OF THE INITIAL RESORPTION FOLLOWING REPLANTATION. Ladanyi, J.; Kertesz, L.; Tompa, Gy.; Gyoengyoessi, G. (Univ., Debrecen, Hungary). Radiol. Diagn., 7: 777-83(1966). (In German).

The examination of the fluid exudation by isotopes is suited for the study of replantation and of the reactions taking place with it. Using ^{24}Na the passage of the replantation plane was demonstrated proximally as well as distally the isotopes being administered two hours after replantation. Within two hours 10 to 15 percent of the radioactive iodine injected into the replanted end of the extremity enter the systemic circulation and are accumulated in the thyroid gland. A passage of the replantation plane could be demonstrated in cases of successful replantation only. This observation offers the possibility of elaborating to a prognostical test that might be of great practical importance for plastic surgery. (auth)

45536 QUANTITATION OF PHOSPHOLIPID ANALYSIS USING ^{32}P BY A DIGITAL COMPUTER METHOD IN METABOLIC EXPERIMENTS ON NIEMANN–PICK DISEASE. Holtz, Albert I. (Bio-Science Lab., Van Nuys, Calif.). J. Amer. Oil Chem. Soc., 44: 80-5(Feb. 1967).

Methods involving ^{32}P uptake into cell cultures, quantitative phospholipid analyses, and computerized data analyses were developed to investigate the biochemical defect in Niemann-Pick disease. Analysis of phospholipids labeled with ^{32}P posed the problem of determining P in the presence of extraneous lipid and chromatographic material, and the assay of ^{32}P an isotope with a half-life of only 14.3 days. Decay of the ^{32}P during the procedures causes loss of counts and obscures relations between different experiments. A computer program was devised to calculate and tabulate the final data in terms of cpm and correct for the decay of the isotope following the time injection into the experment, including subtraction of the background from each sample. This computer method is also recommended for the analysis of other relatively short-lived isotopes especially in the biochemical field where time-consuming chemical manipulations of many samples must be made between the initial metabolic experiment and the final chemical analysis of the metabolites. The results of the analysis indicated a normal synthesis of sphingomyelin, which considering the 3-fold increase in total sphingomyelin, suggested a decreased ability of cells to catabolize sphingomyelin in Niemann-Pick disease. (BBB)

45537 PHYSICAL, CHEMICAL, AND ENZYMATIC PROPERTIES OF RIBONUCLEASE S-PEPTIDE X-IRRADIATED IN SOLUTION. Mee, Lorna K.; Adelstein, S. J. (Harvard Medical School, Boston). Radiat. Res., 32: 93-111(Sept. 1967).

The radiolysis of ribonuclease-S peptide was studied in dilute solution. The G value of 1.7 for loss of activity was significantly higher than that of ribonuclease-A, ribonuclease-S, and the S-protein. The major chemical change was the oxidation of methionine sulfur; this, leading to a decrease in the affinity for S-protein, appeared to be a principal cause of inactivation. In addition, hydroxylation of phenylalanine, the production of ammonia and carbonyl compounds, and minor changes in electrophoretic pattern were observed following irradiation. No evidence was obtained for peptide fragmentation by separation with gel chromatography. (auth)

45538 NEW HEMATOCRIT CORRECTION FOR THE UPTAKE IN VITRO OF ^{131}I-TRIIODOTHYRONINE BY ERYTHROCYTES. Wechselberger, E.; Knapp, U.; Kallee, E. (Univ., Tuebingen, Ger.). Acta Isotop., 6: 159-67(1966). (In German).

A simple hematocrit correction for the ^{131}I-triiodothyronine test of Hamolsky et al., is described. The correction method makes use of the addition or subtraction of absolute K' values in the 20% to 80% range of hematocrit. The correction amounts depend solely on the hematocrit and are independent of the level of the triiodothyronine test values. (auth)

45539 THE TRANSFERENCE OF ^{89}Sr FROM THE SHELL TO THE DEVELOPING CHICK EMBRYO. Creger, C. R.; Colvin, L. B. (Texas A and M Univ., College Station). Radiat. Res., 32: 131-7(Sept. 1967).

Data on the transference of ^{89}Sr from the shell to the embryo indicated that the uptake of ^{89}Sr closely paralleled the ossification of the embryonic bones. It was also observed that about one-third of the ^{89}Sr of the shell was withdrawn by the twentieth day of incubation, and most of this could be accounted for in the developing embryo. Egg production and hatch of fertile eggs were effectively reduced, but fertility was not significantly reduced by ^{89}Sr administration. (auth)

45540 EFFECT OF RADIATION ON THE SURVIVAL IN VITRO OF RAT THYMOCYTES OF DIFFERENT SIZE. Rixon, R. H. (Chalk River Nuclear Labs., Ont.). Radiat. Res., 32: 42-53(Sept. 1967).

The two-component nature of the dose-survival curves obtained for isolated thymocytes of different size suggested that, once lethal damage was initiated by radiation, the rate at which thymocytes underwent interphase death was dependent on physical and chemical processes within the cell and independent of the inducing dose of radiation. The fact that survival following high doses of radiation decreased as the size of the thymocyte increased indicated that the rate of nuclear death increased with size, presumably owing to differences in the metabolic activity of the cells. The

radiosensitivity, based on the slopes of the dose-dependent components of the dose-survival curves, was greatest for the large cells in the isolated thymocyte population. This was assumed to be due to a greater sensitivity of some function or structural state within the nucleus of large cells. (auth)

45541 ELECTRON SPIN RESONANCE OF TWO GLYCINE PEPTIDES IRRADIATED AT 77°K. **Mangiaracina, Richard S. (Roswell Park Memorial Inst., Buffalo). Contract AT(30-1)-3558. Radiat. Res., 32: 27-34(Sept. 1967). (NYO-3558-9).**

Single crystals of α-glycylglycine, x irradiated at 77°K, give four line ESR spectra — the result of the odd electron's interacting with two protons. The main interaction is with the single methylene proton that remains attached to the α-carbon after irradiation. The weaker interaction is with one of the other two methylene protons in the molecule. A seven atom π system, the result of radiation damage, is postulated to explain the delocalization of the electron. In acetylglycine radicals, a similar situation exists. A synthesis of acetylglycine was carried out in which methyl hydrogens were replaced by deuterium. Radicals produced in crystals of this compound give significantly sharper ESR absorption spectra than those of undeuterated acetylglycine. The difference in line width implies a delocalization of the odd electron resulting in interaction with methyl protons. A small nitrogen hyperfine splitting is detected in the spectra of deuterated acetylglycine. Hückel-type molecular orbital theory accounts for the main features of the spin density distribution in these radicals. (auth)

45542 INCORPORATION OF VARIOUS METAL IONS INTO IN VIVO- AND IN VITRO-PRODUCED MELANIN. **Bruenger, F. W.; Stover, B. J.; Atherton, D. R. (Univ. of Utah, Salt Lake City). Radiat. Res., 32: 1-12(Sept. 1967).**

Small amounts of a number of metal ions have been found in melanins obtained from natural sources, and ^{140}Ba and ^{226}Ra have been found to deposit in tissues containing melanin. In this study some aspects of the chemical nature of the incorporation were investigated with radionuclides of high specific activity. The uptake of metal ions by synthetic melanin from a physiological buffer increased with decreasing hydrated ionic radius, decreased with decreasing pH, and decreased in the presence of chelating agents. Replacement of melanin bound Ra^{++} and H^{+} demonstrated the reversibility of the reaction. Comparative studies with synthetic melanin and natural melanin plus its protein showed that the role of the protein in the reactions is small. Both the reaction characteristics and the chemical structures of melanin and of weak acid cation exchangers are similar; this suggests that metal ions and melanin interact by ion exchange. (auth)

45543 STUDIES ON RESIDUE ANALYSIS OF PESTICIDES IN PLANT MATERIALS. I. BEHAVIOR OF MERCURY IN RICE PLANTS APPLIED WITH ^{203}Hg-ORGANO-MERCURY DISINFECTANTS. **Tomizawa, Chojiro (National Inst. of Agricultural Sciences, Tokyo). Shokuhin Eiseigaku Zasshi, 7: 26-32(Feb. 1966). (In Japanese).**

Mercury-203-labeled pesticides were used to study the behavior of mercury in rice plants. Labeled phenylmercuric acetate quickly penetrated rice tissues and was concentrated in newly developing parts of the plant. The radioisotope was accumulated in the rice grains in plants at the heading stage following application either by injection into leaf sheaths or by dipping of the leaf blade. In plants in which the leaves were infected with blast disease, ^{203}Hg from phenylmercuric acetate absorbed from the roots was accumulated in the tissues surrounding the infected lesion of the leaves. Penetration into the tissues was different for pesticides administered in the form of emulsions and in those administered in the form of dusts. Mercury pesticides applied in the form of a dust were less phytotoxic. Mercury content in rice grains was determined after application of ^{203}Hg-labeled phenylmercuric acetate, phenylmercuric chloride, phenylmercuric dinaphthylmethane disulfonate, N-phenylmercuric p-toluenesulfonanilide, N-ethylmercuric p-toluenesulfonanilide, or methoxyethylmercuric chloride applied to the rice plants either at the tillering or flowering stage. Mercury content was lowered in the grain by the refining process. Polished rice retained 50 ppM of the organic mercury pesticides, ranging from 0.1 ppM after application in the tillering state to from 0.146 to 0.528 ppM after application to the flowering state. Age increases sensitivity of rice plants to pesticide concentration. (NSA of Japan) (TSS)

45544 COMPARATIVE TOXICITY OF ^{238}Pu AND ^{239}Pu IN THE RAT. **Ballou, J. E.; Thompson, R. C.; Clarke, W. J.; Palotay, J. L. (Pacific-Northwest Lab., Richland, Wash.). Health Phys., 13: 1087-92(Oct. 1967).**

The enhanced acute toxicity of ^{239}Pu as compared on an equivalent microcurie basis with ^{238}Pu was evidenced by mortality data, by weight loss, by hematological and by histopathological observations. This difference in toxicity would seem to be most reasonably explained in terms of the different patterns of internal deposition of the two isotopes, which, in turn, may be explained by differences in physical state of the isotopes resulting from the 270-fold greater mass associated with an equal-microcurie quantity of ^{239}Pu. No evidence was seen of direct chemical toxicity of ^{239}Pu. (auth)

45545 STUDIES ON THE RETENTION AND METABOLISM OF INHALED METHYL IODIDE. I. RETENTION OF INHALED METHYL IODIDE. **Morgan, D. J.; Morgan, A. (Atomic Energy Research Establishment, Harwell, Eng.). Health Phys., 13: 1055-65(Oct. 1967).**

Methyl iodide is one of the forms in which radioiodine may be released in accidents involving fission products. In order to provide information to assist in the assessment of the radiological hazard resulting from its inhalation, experiments were carried out in which volunteers inhaled iodine-132 labeled methyl iodide. Retention values ranging from 53 to 92% of the amount inhaled were obtained. The retention is highly dependent upon respiratory rate, low rates being associated with high retention, and vice versa. In order to study the effect of respiratory rate and tidal volume on retention, additional experiments were carried out. These showed that there is negligible absorption in the respiratory dead space and that, at normal breathing rates, absorption from alveolar air is incomplete. The average dose equivalent to the thyroid was about 3 mrem. (auth)

45546 EFFECT OF STEM RUST ON THE UPTAKE AND INCORPORATION OF ^{32}P BY WHEAT SEEDLINGS. **Mukherjee, K. L.; Shaw, M. (Banaras Hindu Univ., India). Indian Phytopathol, 18: 250-2(1965).**

Rust infection increased uptake of ^{32}P by wheat seedlings. Radioactivity increased more in the total organic phosphates than in the total inorganic phosphate fraction of infected leaves. This fall of PI/PO ratio was indicative of increased synthetic activity in the host-parasite complex. (Indian Sci. Abstr.)

45547 THE INFLUENCE OF DEEP X IRRADIATION OF THE LIVER ON FORMATION OF CONJUGATED SULFATES AFTER LOADING WITH N-ACETYL-p-AMINOPHENOL IN RABBITS. **Birzle, Hermann; Beck, Kurt; Dieterich, Ekkehart (Univ., Freiburg i. B.). Strahlentherapie, 133: 602-9(Aug. 1967). (In German).**

The influence of x ray deep irradiation of the liver on sulfate conjugation after N-acetyl-p-aminophenol loading was investigated in rabbits. Single exposure with 1000 R resulted in a significantly diminished synthesis and excretion of conjugated sulfates. The disturbance was reversible within 14 days. Fractionated irradiation of the liver with 6000 R (20 × 300 R) did not impair detoxication by conjugated sulfates. (auth)

45548 EVOLUTION OF VASCULARIZATION OF A SOLID TUMOR OF MICE DURING THE COURSE OF GROWTH. **Robert, Jacques; Martin, Jean; Burg, Constant (Laboratoire de Physique Medicale, Nancy). Strahlentherapie, 133: 621-30(Aug. 1967). (In French).**

The blood supply of a transplanted solid tumor of C3H mice was studied by the method of resorption of radioactive xenon. A small tumor has the same blood supply as skin or muscle but the blood flow decreases rapidly as the tumor grows. (auth)

45549 INDUCTION OF MUTANTS WITH ALTERED DNA COMPOSITION: EFFECT OF ULTRAVIOLET ON BACTERIUM PARACOLI 5099. **Gause, G. F.; Dudnik, Yu. V.; Laiko, A. V.; Netyksa, E. M. (Inst. of New Antibiotics, Moscow). Science, 157: 1196-7(Sept. 8, 1967).**

Cultures of Bacterium paracoli 5099 represent a favorable system for induction of mutants with altered DNA base composition. The frequency of induction of these mutants by ultraviolet radiation is strongly dose-dependent, and has a peak at the ultraviolet exposure equal to 860 ergs. On both sides of this maximum the rate of appearance of mutants decreases, and with the exposures less than 350 and more than 1900 ergs per square millimeter, mutants with altered DNA base composition do not appear at all. (auth)

45550 ON THE PHOTODYNAMIC FUROCUMARINE REACTION MECHANISM: PHOTOREACTION OF PSORALIN-4-^{14}C WITH DNA, RNA, HOMOPOLYNUCLEOTIDES, AND NUCLEOSIDES. **Krauch, C. H.; Kraemer, D. M.; Wacker, A. (Univ., Frankfurt am Main). Photochem. Photobiol., 6: 341-54(May 1967). (In German).**

The uv-induced reaction of furocumarine derivatives with nucleic acids was studied using light with a wavelength of 365.5 nm. The uv-induced binding of psoralen to DNA and RNA was demonstrated using different methods. This binding was found to be mainly located either at thymine or uracil. The concentration

and pH dependency were studied. The photoproduct obtained with uridine was isolated paper chromatographically and was split into initial components photochemically. The results indicated that psoralen with its 3,4-double bond is able to form a cyclic derivative with the C_5-C_6 double bond of thymine or uracil under the action of uv light. (BBB)

45551 INVESTIGATIONS ON THE CONTRAST VALUES OF RADIOACTIVE SUBSTANCES OF DIFFERENT QUANTUM ENERGY TESTED ON ^{125}I, ^{131}I, AND ^{132}I. Guntermann, S.; Dalluege, K. H. (Humboldt Univ., Berlin). Radiol. Diagn., 7: 627-30(1966). (In German).

Results confirmed the expectation that increase of the quantum energy yields scintigrams of higher information content. Iodine-125 was a useful indicator up to an object depth of 1.5 cm, while ^{132}I surpassed the contrast value of ^{131}I when the object was deeper than five cm. (auth)

45552 BEHAVIOR OF MOLYBDATE AND TECHNETATE IN HUMAN BODY. Woller, P.; Hennig, K.; Strietzel, M. (Radiologische Klinik, Dresden). Radiol. Diagn., 7: 611-18(1966). (In German).

The radioisotopes ^{99}Mo and its daughter product ^{99m}Tc were introduced to nuclear medicine in recent times. The behaviour of molybdate and technetate in the human body was investigated in view of their application. Intravenously injected molybdate was quickly taken over by the liver, whereas technetate appeared in the thyroid gland, salivary glands, stomach and kidneys. Both compounds were excreted mainly in the urine. The uptake of technetate by the thyroid gland allowed a scintigraphic visualization of the organ. The uptake by the thyroid gland depended widely on its functional state so that, with certain reservations, it could be used for functional diagnosis. The high uptake of molybdenum by the liver led to satisfactory scintigrams. It was concluded that the scintigraphy should be begun when enough ^{99}Tc has been formed through disintegration of ^{99}Mo, as the former can be visualized better and obviously remains in the liver. ^{99}Mo visualizes the liver like rose bengal, but was retained longer in the liver and did not visualize the gall bladder. For investigations of the thyroid gland, technetate distinguished itself through an extremely small radiation dose. On the basis of the results obtained, the suitability of ^{99}Mo and ^{99m}Tc for the above mentioned investigations was confirmed. (auth)

45553 EFFECT OF X RAYS ON THE ACTIVE TRANSPORT OF SODIUM THROUGH FROG SKIN. Astudillo, M. D.; Sanz, F.; Lopez Zumel, M. C. (CSIC, Madrid). An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. B, 63: 827-32(July-Aug. 1967). (In Spanish).

The purposes of this investigation are to study the type of transport of different ions through biological membranes, and to modify this transport by the action of different agents. The skin of the frog, Rana esculenta, was used as membrane, and the sodium ion of the Ringer solution was labeled with ^{22}Na. To modify the transport, x rays with doses of 1,000, 5,000, 7,500, and 10,000 R were used. The kinetics of the flux entering and leaving were studied at different periods of time during 7 hours to measure the radioactive specimens of ^{22}Na. On the basis of the membrane potential data, the theoretical relation of the fluxes was calculated using the Ussing equation, and from comparison with the experimental relation of the fluxes, the type of transport was derived. The result of this study is that weak doses of x rays increase the entering flux of sodium, but if the doses of x rays continue to increase, the flux diminishes and its value becomes approximately normal. From the comparison of the ratio of the fluxes in the normal membranes and those irradiated at 5,000 R, it is seen that their difference has an important effect from the point of view of the active transport of sodium. (tr-auth)

45554 PREPARATION OF ^{14}C-LABELED TUBERCULIN PURIFIED PROTEIN DERIVATIVE. Landi, S.; Held, H. R.; Hauschild, A. H. W.; Hilsheimer, R. (Univ. of Toronto). Appl. Microbiol., 15: 839-43(July 1967).

Carbon-14-labeled tuberculin purified protein derivative (^{14}C-tuberculin PPD) was prepared from culture filtrates of Mycobacterium tuberculosis var. hominis grown in a culture medium containing uniformly labeled ^{14}C-amino acids. With a mixture of ^{14}C-amino acids (an acid hydrolysate of ^{14}C-Chlorella protein) in the medium, the recoveries of ^{14}C in the final product were higher than with ^{14}C-labeled-L-glutamic acid. ^{14}C-tuberculin PPD was separated into tuberculoprotein and nucleic acid by paper electrophoresis. The specific radioactivity of tuberculoprotein was substantially greater than that of the nucleic acid. ^{14}C-tuberculin PPD is advocated as a means to measure the adsorption of tuberculin to glass or other surfaces. It could also prove useful as a means to study the structure and mode of action of tuberculin. (auth)

45555 USE OF TRITIATED WATER (THO) FOR CONTINUOUS REGISTRATION OF INSECT TRANSPIRATION. Kloft, W.; Schulze, E.-F. (Univ., Wuerzburg, Ger. Univ., Bonn). Atompraxis, 13: 265-8(June 1967). (In German).

A continuous registration of the insect transpiration could not be realized until now. Applied THO mixes with the normal body water and therefore is released simultaneously by the insect while transpiring. It can be continuously measured and registered by means of an ionization chamber of 100 cm^3 capacity and a vibrating-reed electrometer with recorder attached. To reduce the memory-effect the interior surface of the chamber is plated with gold. All environmental factors influencing the transpiration of insects such as temperature, air humidity and wind velocity can be varied in the described apparatus. This method offers the opportunity to follow the course of transpiration qualitatively over a long period as well as to detect spontaneous regulating effects. (auth)

45556 CATABOLISM OF SERUM ALBUMIN IN THE IRRADIATED RABBIT. Lefaure, J.; Cier, J. F.; Cier, A. (Faculte de Medecine et Pharmacie, Lyon). Compt. Rend. Soc. Biol., 160: 2367-70(1966). (In French).

The effects of whole-body γ-irradiation at doses from 120 to 800 R were studied in the rabbit, using labeled albumin to measure the biological half-life of the serum albumin. Four series of tests were made with the labeled albumin being injected immediately after the irradiation and 3, 9, and 16 days after the irradiation. In non-irradiated controls a biological half life of 27.6 hrs was found for the serum albumin. In irradiated rabbits, the biological half-life decreased significantly at doses above 120 R. The maximum effect was observed after nine days. (J.S.R.)

45557 INVESTIGATIONS ON NUCLEOHISTONES. III. EFFECTS OF X RADIATION. Vogt, Margarete; Harbers, Eberhard (Univ., Goettingen, Ger.). Strahlentherapie, 133: 426-33(July 1967). (In German).

The effect of x rays on nucleohistones immediately after irradiation was investigated using various methods. In model experiments with nucleohistones isolated from Ehrlich ascites tumor cells x irradiation caused a dose-dependent decrease of the template activity for the RNA polymerase from Escherichia coli. In eu- and heterochromatin fractions, isolated from intensively irradiated nuclei, no significant differences could be observed using several analytical methods; only the template activity for the RNA polymerase (increased in eu-, decreased in heterochromatin) and the viscosity of heterochromatin (somewhat increased) were found to be changed. After irradiation of whole Ehrlich ascites tumor cells there was less binding of actinomycin to the DNA of euchromatin; however, the ratio of the amounts of eu/heterochromatin was unchanged. (auth)

45558 STRONTIUM METABOLISM. Proceedings of the International Symposium held at Chapelcross, Glasgow, and Strontian, May 5–7, 1966. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967. 354p. 84s. (CONF-660561).

The conference included 37 papers, under the following sectional headings: historical; fallout studies; tracer studies in man; tracer studies in animals; modification of strontium metabolism. Separate abstracts are prepared for 35 of these papers. (UK)

For abstracts of individual papers see: 45559–45592 and 45647.

45559 A COMPARISON BETWEEN ^{45}Ca AND ^{85}Sr ABSORPTION, EXCRETION, AND SKELETAL UPTAKE. Shimmins, J. (Western Regional Hospital Board, Glasgow); Smith, D. A.; Nordin, B. E. C.; Burkinshaw, L. pp 149–59 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

The absorption, faecal and urinary excretion and bone mineralization rates (M) of ^{85}Sr and ^{45}Ca were compared by following the continuous feeding of the isotopes at different levels of dietary Ca. The net absorption of ^{85}Sr was found to be less than that of ^{45}Ca at all levels of Ca intake. The net absorption of both isotopes fell as the Ca intake was increased. The urinary excretion and skeletal retention of both isotopes also decreased with increasing Ca intake. A discrimination factor of 3.34 in favor of ^{85}Sr compared to ^{45}Ca was found in the kidneys when simultaneous blood and urine samples were compared. The bone-mineralization rates calculated from ^{85}Sr and ^{45}Ca were not found to differ significantly. The bone-mineralization rates were also estimated by the method of Bauer et al., by following the simultaneous intravenous administration of both isotopes, and the data combined with those of Dow and Stanbury. The ^{85}Sr bone-mineralization rate was found

to correlate with the ^{45}Ca bone-mineralization rate, but there were large individual discrepancies. (auth) (UK)

45560 RATIO OF THE FAECAL TO URINARY CLEARANCE OF STRONTIUM IN MAN. Harrison, G. E.; Sutton, Alice (Medical Research Council Radiobiological Research Unit, Harwell, Eng.). pp 161-6 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

Measurements of the ratio of the faecal to the urinary clearance of Sr are reported for five human adults on a controlled diet corresponding to a daily intake of 1.6 g Ca and 1 mg Sr. Values of the ratio of the endogenous faecal to the urinary output of ^{85}Sr were also obtained for two male adults following a single intravenous injection of the radioactive marker. Results from the two experiments are compared, and the importance of the ratio of the endogenous faecal to the urinary output of Sr in the assessment of oral absorption is discussed. (auth) (UK)

45561 A COMPARISON OF THE METABOLISM OF CALCIUM AND STRONTIUM IN RABBIT AND MAN. Lloyd, Elizabeth (Churchill Hospital, Oxford). pp 167-73 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

The reduced uptake and retention of radioactive Sr in the adult rabbit compared with man is the result of many dietary and physiological differences. The most important of these are probably the absence of dairy products from the rabbit's diet, the continuous feeding habits of the rabbit, and the presence of large quantities of bile in the gastro-intestinal tract. The renal tubular reabsorption of Ca in the rabbit was considerably lower than that reported for humans, which may in turn be linked with the higher concentrations of citrate found in rabbit blood. The greatly increased rate of transfer of Sr and Ca ions from diet to bone in the rabbit compared with man provides an opportunity to study the uptake and release of a radioactive isotope in a time interval that is about ten to twenty times shorter than the corresponding time in man. (auth)

45562 THE ROLE OF OXIDATIVE PHOSPHORYLATION IN CALCIUM AND STRONTIUM ABSORPTION FROM THE GASTRO-INTESTINAL TRACT. Taylor, D. M. (Inst. of Cancer Research, Sutton, Eng.). pp 175-9 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

Orally administered tracer doses of ^{45}Ca and of ^{85}Sr given to suckling rats were almost totally absorbed from the gastrointestinal tract. The high absorption and lack of discrimination contrast with the pattern observed in adult rats and in other animals. A study of the influence on Ca and Sr absorption of known inhibitors of oxidative phosphorylation suggests that the metabolically dependent block which normally restricts the passage of Ca across the small intestine is inhibited by lactose (and possibly other substances) present in milk diet. Similar mechanisms may operate for Sr and Ba. (auth) (UK)

45563 STUDIES ON THE DYNAMICS OF STRONTIUM METABOLISM UNDER CONDITION OF CONTINUAL INGESTION TO MATURITY. Goldman, Marvin; Della Rosa, R. J. (Univ. of California, Davis). pp 181-94 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

Over 100 beagles were reared on diets containing constant ^{90}Sr/Ca from intra-uterine time to adulthood at 1.5 years. On a diet containing 1% Ca and Ca/P ratio of 1.5, skeletal burdens of ^{90}Sr approximated to ten times the total daily intake level. During intra-uterine growth, discrimination via the placenta resulted in ^{90}Sr/Ca ratios in fetal bone of 0.1 that of the maternal diet. Discrimination during nursing changed the observed ratio of skeletons of weaned pups to 0.2 of the maternal diet. When fed the diet directly, the pups rapidly equilibrated to an observed ratio of about 0.4, with maximal rate of body burden accretion seen at 3 to 4 months of age. By 8 to 10 months of age the adult skeletal mass was achieved and was uniformly labelled as the ^{90}Sr/Ca. Following removal of ^{90}Sr from the diet, at 1.5 years of age, the skeleton lost ^{90}Sr at a rate proportional to the integrated effect of remodelling and exchange with the greatest effect seen in the trabecular skeletal regions, e.g., epiphysis, sternum. Teeth reflected a minimal rate of change. Total body monitoring of ^{90}Sr bremsstrahlung indicated varying individual retention functions, with the mean retention following a power function exponent of about -0.4 corresponding to an effective half period of about 5 to 6 years. (auth) (UK)

45564 VARIATION IN TURNOVER RATES IN DIFFERENT PARTS OF THE SKELETON IN RELATION TO TUMOUR INCIDENCE DUE TO ^{90}Sr DEPOSITION. Vaughan, Janet; Williamson, Margaret (Churchill Hospital, Oxford). pp 195-206 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

In connection with an analysis of the sites of tumor incidence in rabbits given ^{90}Sr a study was made of turnover rates of ^{90}Sr in different bones and at different sites in the same bone. It is concluded that bone sites with a slow turnover rate are at carcinogenic risk when the ^{90}Sr intake is low. When the intake is high, sites with a medium turnover rate are vulnerable. When turnover rate is rapid the risk is less. (auth) (UK)

45565 STUDIES ON SOFT TISSUE DOSAGE FROM ^{90}Sr. Brues, A. M.; Auerbach, H.; Grube, D.; DeRoche, G. (Argonne National Lab., Ill.). pp 207-12 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

Young adult male mice were injected intravenously with ^{85}Sr and the activities of blood and soft tissues were measured at serial sacrifices. After the first few hours, these activities declined at such a rate that the retention could be approximately described by the function $R = At^{-1.3}$. The values for the testis, per g wet weight, were about 60–80% of those for whole blood; muscle and other soft tissues were generally about the same, except that kidney and intestine were somewhat higher for the first few hours and seminal vesicles (with contents) and salivary gland remained higher than blood for several days. Total integrated retention appeared to be about 0.4 day (as μCi days/g per μCi/g injected) for blood and about 0.2 day for testis and most soft tissues. Injection of ^{90}Sr (from which ^{90}Y was removed before injection) confirmed these findings, and measurements of ^{90}Y at sacrifice indicated an excess above the equilibrium ^{90}Sr concentration in liver and spleen. The absolute ^{90}Y excess declined with time, along with the decline in soft-tissue ^{90}Sr concentration, suggesting that its source was mainly Y produced endogenously by Sr decay in soft tissues. The ^{90}Y activity in blood remained consistently at about 10% of the ^{90}Sr activity. (auth) (UK)

45566 INHIBITION OF ABSORPTION OF RADIOACTIVE STRONTIUM BY ALGINIC ACID DERIVATIVES. Waldron-Edward, Deirdre; Paul, T. M.; Skoryna, Stanley C. (McGill Univ., Montreal). pp 329-41 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

Naturally occurring polyuronic acids were shown to be capable of complexing with Sr ions in vivo, rendering them unavailable for transfer across the intestinal mucosa. This finding has an important practical application in connection with radioactive Sr in diet. Extension of this application to human subjects poses many problems, including dosage and mode of administration of alginate derivatives, effects of salts of alginic acid other than sodium salts, the intestinal binding of resecreted radioactive Sr, and differences in inhibitory ability of different samples of alginate. These problems were studied with rats as experimental animals. Under normal laboratory feeding conditions sodium alginate reduces ^{85}Sr absorption and bone uptake in constant proportions. This was observed at a high level of alginate intake (24% diet), at a low level (1.4%) and at an intermediate level. Calcium-45 uptake in the bone is also affected by long-term feeding with high levels of alginate. Growth-rate and balance studies showed that interference with Ca metabolism is not sufficient to be detrimental to the health of young growing rats in the period under observation. Preliminary experiments have shown that calcium alginate can be substituted for sodium alginate in the inhibition studies, in order to boost Ca intake. This finding is interesting because of the implication that alginate acts as a specialized type of ion-exchange material. It

also offers new possibilities in the investigation of the complex problem of the kinetics of Ca absorption. Alginate increases the rate of fecal excretion of endogenous radiostrontium from rats and from kittens. It is suggested that alginate feeding may be of value in removing previously absorbed ^{91}Sr, introduced by accidental ingestion or by inhalation. Sodium alginates extracted from various seaweeds, as well as material obtained from commercial sources, showed wide differences in their ability to inhibit the absorption of radioactive Sr. The relationship of these variations to differences in chemistry of the preparations studied is discussed. (auth)

45567 SOME ASPECTS OF ^{90}Sr METABOLISM IN MINIATURE SWINE INGESTING ^{90}Sr DAILY. McClellan, R. O.; Beamer, J. L.; Sheldon, P. L. (Battelle-Northwest, Richland, Wash.). pp 213-22 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

The effect of two diets, varying in Ca and P content, on ^{90}Sr metabolism was studied in three generations of miniature swine chronically exposed to ^{90}Sr. The diets, which contained either 1.5% Ca and 0.8% P or 0.55% Ca and 0.50% P, as well as 25 μCi ^{90}Sr, were fed to two groups of female miniature swine beginning at 11 months of age. When killed 7 months later the high Ca animals contained 85 μCi ^{90}Sr and the low Ca animals 190 μCi ^{90}Sr. The body burden of ^{90}Sr of animals (F_1 generation) born to the original generation increased with age as they were continuously exposed to ^{90}Sr. The high Ca F_1 generation animals had a skeletal burden of 190 μCi ^{90}Sr when killed at 19 months of age; the low Ca animals contained 360 μCi ^{90}Sr. The newborn F_2 generation animals on the high Ca diet derived 28%, and the low Ca F_2 generation 39% of their ^{90}Sr from the maternal skeleton that was present before conception. For the skeleton formed between birth and weaning (that originating from milk Ca and ^{90}Sr), 48% for the high Ca diet, and 54% for the low Ca diet, of the skeletal ^{90}Sr, originated from maternal skeleton present before conception. The comparative metabolism of ^{90}Sr and Ca was similar for both diets. The $^{90}Sr/Ca$ ratio of the milk was about 0.10 that of the diets. The ratio for the skeleton of newborn animals was about 0.15 that for the dam's skeleton. The $^{90}Sr/Ca$ ratio for skeleton formed during the suckling period was near unity, relative to the diet of dam's milk. After weaning and being placed on an adult diet, the $^{90}Sr/Ca$ ratio of the skeleton relative to that of the diet decreased to values of 0.10 to 0.13. (auth) (UK)

45568 METABOLISM OF ^{89}Sr AND ^{45}Ca GIVEN ORALLY TO PIGS 1, 3, OR 7 DAYS AFTER WHOLE-BODY IRRADIATION. Bell, M. C.; Lowrey, R. S.; Withrow, G. (Univ. of Tennessee, Oak Ridge). Contract AT(40-1)-GEN-242. pp 223-7 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

Early plasma uptake of both ^{89}Sr and ^{45}Ca was reduced in young, rapidly growing pigs dosed at 1 or 3 days after exposure to whole-body ionizing radiation (450 rads). From 8 to 72 h after dosing, this effect was reversed. Data from pigs dosed 7 days after irradiation were not different from controls. No significant treatment differences were found in urinary and faecal excretion of ^{45}Ca, ^{89}Sr and nitrogen. ^{89}Sr retention in tibia of pigs dosed 1 day after whole-body irradiation was greater than in control pigs. (auth) (UK)

45569 INFLUENCE OF ADSORPTION OF STRONTIUM IN FOOD ON THE ^{85}Sr BODY BURDEN IN GUINEA PIGS. van der Borght, O.; Kirchmann, R.; van Puymbroeck, S. (Belgian Nuclear Center, Mol). pp 229-36 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

Solubility of ^{85}Sr in food material, as determined by extraction with water, sodium nitrate and acids, seems not the determining factor for ^{85}Sr assimilation in guinea pigs, and gives divergent results under varying conditions. Presence of food in the stomach when given a liquid dose of $^{85}SrCl_2$ can lower the assimilated ^{85}Sr about three times as compared with intubation on an empty stomach in fasted animals. Distribution of the absorbed Sr between intestine, femur, liver, kidney, muscle, eye and testes is compared with ^{226}Ra and ^{45}Ca content of some of these organs when radiocontamination with these isotopes occurred under similar conditions. (auth) (UK)

45570 ^{90}Sr TRANSFER TO PROGENY VIA PLACENTA AND MILK. Burykina, L. N. (Dept. of Public Health, Moscow). pp 237-45 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

Chronic exposure of dogs to ^{90}Sr at equilibrium with ^{90}Y caused a placental transfer to the whole litter of 1.4 ± 0.3% of the amount received within the period of pregnancy, or 4.9 ± 0.8% of the activity retained in the maternal skeleton. Bone concentrations in the progeny at birth were 17 to 46% of those in the maternal skeletons. The amount transferred through the placenta to the whole litter 2.5–5 years after cessation of mothers' exposure was 0.4–0.05% of that retained in the maternal skeleton or about 1 to 6% of the average placental transfer obtained at the time of chronic ^{90}Sr ingestion. ^{90}Sr intake with maternal milk under the conditions of chronic exposure of mothers exceeds the values of placental transfer by a factor of 10 to 17. The amount of radioactive Sr in the litter of one dog may be as high as 80% of the mother's body burden. The kinetics of the metabolism of ^{90}Sr transferred to the progeny by the two routes specified can be well fitted into a two-compartment exponential model, the slowly metabolizing fraction having an effective half-life of about 2,000 days. (auth) (UK)

45571 EFFECT OF DIETARY STRONTIUM ON REPRODUCTIVE PERFORMANCE OF THE LAYING HEN. Mraz, F. R.; Wright, P. L.; Ferguson, T. M. (Univ. of Tennessee, Oak Ridge). Contract AT(40-1)-GEN-242. pp 247-53 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

Thirty yearling SCW Leghorn hens were fed a diet containing 2.8% Ca plus 0.0, 0.5, 1.0, 2.0 or 4.0% Sr for 4 weeks before receiving ^{45}Ca and ^{89}Sr orally. Egg production, strength of egg shell, and hatchability were reduced on the 2 and 4% Sr diets. The deposition of both ^{89}Sr and ^{45}Ca in the egg shell and the tissues increased as the level of Sr in the diet increased. (auth) (UK)

45572 URINARY/FECAL EXCRETION RATIOS OF STRONTIUM AND CALCIUM IN THE RAT. Thompson, R. C.; Hackett, P. L. (Battelle-Northwest, Richland, Wash.). pp 255-60 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

Following the intraperitoneal injection of ^{45}Ca and ^{85}Sr to mature rats on a high Ca diet, the ratio of urinary/fecal excretion of both radionuclides decreased with time after injection. The decrease after 47 days was to half the initial values for ^{45}Ca, and to one-sixth the initial values for ^{85}Sr. This effect was shown to be due to an increase in excretory clearance via the intestine. (auth) (UK)

45573 RADIOSTRONTIUM, STABLE STRONTIUM, STABLE CALCIUM, AND PHOSPHORUS IN SPERM DNA. Aberg, Bertil; Gillner, Margot (Royal Veterinary Coll., Stockholm). pp 261-3 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

In spermatozoa from rams the DNA was analysed as well as the Ca and Sr content. The numbers of atoms of radiostrontium (^{89}Sr and ^{85}Sr) taken up by the spermatozoon was also determined. The effects of the ionizing radiation from radiostrontium on the sperm DNA are discussed. (auth) (UK)

45574 REMOVAL OF RADIOSTRONTIUM FROM THE MAMMALIAN BODY. Catsch, A. (Technische Hochschule, Karlsruhe, Ger. Institut fuer Strahlenbiologie, Karlsruhe, Ger.). pp 265-81 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

The difficulties inherent in experimental studies on the modification of radiostrontium metabolism are emphasized. A main reason for this is the close resemblance between Sr and Ca with regard to chemical and biological features, in addition to the influence of numerous physiological factors which are difficult to control. This leads to inconsistencies in results. The paper attempts to review

the vast amount of experimental data on enhancement of radiostrontium excretion from the mammalian body, with emphasis on the metabolic fate of a single dose of the radionuclide or diminution of an already existing skeletal burden, under the following headings: Isotopic dilution; Dilution with calcium carrier; Low phosphorus diet; Physiological approach (use of hormone preparations, vitamins, ammonium chloride, magnesium salts, diuretics, barium sulphate, calcium phosphate, alginates, pilocarpine, etc.); and Chelating agents. Future possibilities are outlined. (UK)

45575 HIGH STRONTIUM DIET AND RADIOSTRONTIUM RETENTION. Depczyk, Danuta; Domanski, Tomislaw; Liniecki, Julian (Inst. of Occupational Medicine, Lodz, Poland). pp 283-96 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

High Sr diet was found to reduce the bodily retention of ^{85}Sr by about the same proportion in the rat and in man. Several possible explanations of this observation are discussed. (auth) (UK)

45576 INGESTED OR INJECTED STRONTIUM AS INFLUENCED BY ORAL TREATMENT SHORTLY BEFORE OR AFTER EXPOSURE. Volf, V. (Inst. of Radiation Hygiene, Prague). pp 297-305 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

Experiments with ^{85}Sr on rats in three subject areas are reviewed: Attempts to minimize the radiostrontium absorption from the gastro-intestinal tract by sulphates, phosphates or carbonates. Several mixtures proved most effective provided treatment started almost immediately after Sr ingestion. Effect of these orally administered substances on the excretion, via the gut, of injected radiostrontium. Phosphates increased the faecal excretion of Sr and lowered its urinary elimination, so that the total excretion and retention remained unchanged. Shortly after exposure, sulphates increased the amount of Sr in the small intestine, but later mainly promoted its urinary excretion. The effect of orally administered absorbable chlorides or sulphates on urinary excretion of injected radiostrontium. The excretion pattern and the retention of radiostrontium were influenced when the substances were given shortly before radiostrontium and in sufficient concentrations. (auth) (UK)

45577 EFFECT OF A LOW PHOSPHORUS DIET ON ^{90}Sr TOXICITY IN MICE. van Putten, L. M. (Radiobiological Inst. TNO, Rijswijk, Netherlands). pp 307-12 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

Treatment with a low P diet increased the life span and reduced the incidence of bone tumors in mice injected with ^{90}Sr at a level of 0.3 μCi/g body weight. (auth) (UK)

45578 SKELETAL DISTRIBUTION OF STRONTIUM AND CALCIUM AND STRONTIUM/CALCIUM RATIOS IN SEVERAL SPECIES OF FISH. Ophel, I. L.; Judd, J. M. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 103-9 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

The Sr and Ca contents of different bony tissues were measured in three species of fish. The Sr/Ca ratios in the spinal column of five species were compared with the corresponding ratios in the water. (auth)

45579 INFLUENCE OF DIETARY AND HORMONAL FACTORS ON RADIOSTRONTIUM METABOLISM IN MAN. Spencer, Herta; Lewin, Isaac; Samachson, Joseph (Veterans Administration Hospital, Hines, Ill.). pp 111-29 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

Several aspects of the metabolism of radiostrontium in man are described. The addition of Ca to the diet had an inconsistent effect on radiostrontium absorption, decreasing the absorption in some patients but not in others. The addition of phosphate to both the low and the high calcium intakes resulted in a decrease in the absorption of radiostrontium. Stable Sr did not decrease the absorption of radiostrontium, and further investigations are needed in order to determine whether stable Sr might not increase the absorption of radiostrontium in man. Lactose, lysine and vitamin D had no effect on radiostrontium absorption. The changes in radiostrontium metabolism induced by the administration of estrogen, androgen, progestin and corticosteroids paralleled the changes in Ca metabolism. The most striking change due to endocrine dysfunctions was the increase in radiostrontium absorption following the correction of spontaneous hyperthyroidism and of induced hypermetabolism. In the absence of normally functioning parathyroid glands, i.e., in patients with hypoparathyroidism, the absorption of both radioactive strontium and calcium was very low and was not affected by parathyroid extract. (auth) (UK)

45580 KINETICS OF ^{85}Sr DEPOSITION IN THE SKELETON DURING CHRONIC EXPOSURE. Rundo, J. (Atomic Energy Research Establishment, Harwell, Eng.). pp 131-8 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

The skeletal retention of ^{85}Sr was measured in five healthy men who had been on a constant diet that included milk containing ^{85}Sr for 21 to 32 days. The retention curves were analyzed into three exponential components that indicated average half-lives and average relative compartment sizes of 2.7 days (0.64), 19.2 days (0.18) and 750 days (0.18). The equations for the skeletal content during the intake period gave values that were in reasonable agreement with the observed levels in the two subjects for whom experimenal data were available. (auth) (UK)

45581 AN ATTEMPT TO QUANTITATE THE SHORT-TERM MOVEMENT OF STRONTIUM IN THE HUMAN ADULT. Carr, T. E. F. (Medical Research Council Radiobiological Research Unit, Harwell, Eng.). pp 139-48 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

Results previously reported (after measurements on five subjects fed for 3 or 4 weeks on a diet containing known amounts of stable Sr and ^{85}Sr) were used in conjunction with a simple model to quantitate the movement of Sr in the adult human. Calculations are made of absorbed, retained and excreted fractions of the dietary Sr, as well and Sr removed from bone and either excreted or returned to the bone. Estimates are also given of the Sr balance of the subjects over the periods concerned and of approximate Sr pool sizes and equilibration times. (auth) (UK)

45582 EFFECT OF AGE ON RADIOACTIVE AND STABLE STRONTIUM ACCUMULATION IN MULE DEER BONE. Farris, G. C.; Whicker, F. W.; Dahl, A. H. (Colorado State Univ., Fort Collins). pp 93-102 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

Metacarpal and femur bones of Colorado mule deer (Odocoileus hemionus hemionus) of various age classes were collected in order to study radioactive and stable Sr distribution within a deer herd. Average ^{90}Sr and stable Sr concentrations in bone of six age classes were significantly different. The highest levels of radioactive Sr were in the younger age classes and stable Sr concentrations were larger in the older age groups. Considerable variation in the radioactive and stable Sr content of metacarpals was observed within age classes. No significant difference in radioactive or stable Sr content was observed between the sexes of deer younger than 17 months. Sex was not compared in older age classes because of limited sample size. Estimates of Sr turnover rates indicated values of about 19% per year for juvenile and 6% per year for adult deer. (auth) (UK)

45583 CHRONIC ACCUMULATION OF ^{90}Sr IN THE BODY AS PREDICTED FROM THE RETENTION OF A SINGLE TRACER DOSE. Liniecki, Julian (Inst. of Occupational Medicine, Lodz, Poland). pp 83-91 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5–7, 1966. See CONF-660561.

By using a power function for Sr retention $R_t = At^{-b} = 0.6t^{-0.24}$ with data on the absorption efficiency of this element from the gastrointestinal tract, ^{90}Sr concentration in bones of adults (as expected from contamination of the diet from 1954 to 1963) is calculated for New York City, Poland and Great Britain. Good agreement with direct measurements is apparent. Errors due to extrapolation of the power function beyond the time-range of direct observation are discussed. It is concluded that uncertainty in the extrapolation is of little importance for the prediction of ^{90}Sr accumulation in the body under conditions of chronic intake. (auth) (UK)

45584 STRONTIUM METABOLISM IN MAN. Knizhnikov, V. A.; Marei, A. N. (Inst. of Biophysics, Moscow). pp 71-82 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5-7, 1966. See CONF-660561.

A survey is given of recent work on Sr metabolism in the Soviet Union, leading to the following conclusions: The daily intake of ^{90}Sr with diet during the years 1963-1964 was considerably greater than in the United States. The level of ^{90}Sr in human bone at various age groups in the Soviet Union during these years was about the same as in the United States. It is suggested that the fallout strontium deposited in insoluble form on growing grain crops is less effectively absorbed in the human subject than the soluble Sr compounds present in milk and other dairy products. Bread and grain represent the major source of dietary ^{90}Sr in the Soviet Union, whereas milk and dairy products are the main source in the United States. Addition of Ca to the diet of experimental human subjects reduced the retention and accumulation of ^{90}Sr in bone. Levels of ^{90}Sr in human bone were lower in towns having drinking water with a relatively high fluorine content than in control towns with normal fluorine content. (auth) (UK)

45585 STUDIES IN STRONTIUM METABOLISM. 3. PREFERENTIAL CALCIUM-STRONTIUM RENAL TUBULAR ABSORPTION MEASURED BY ACTIVATION ANALYSIS. Arneil, Gavin C. (Royal Hospital for Sick Children, Glasgow). pp 67-70 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5-7, 1966. See CONF-660561.

Samples of blood and urine were obtained from nine children. The Ca content of each was measured by flame photometry and the Sr content by activation analysis. The ratio of Sr/Ca in urine and plasma was determined for each child. The ratio of Sr/Ca in the urine was higher than in plasma in eight of the nine children. This probably indicates selective preference of Ca to Sr in renal tubular absorption, possibly amounting to 3.4%, although quantitative measurement is difficult. (auth) (UK)

45586 STUDIES IN STRONTIUM METABOLISM. 2. ^{90}Sr IN URINE: CORRELATION WITH DIET AND AGE. Warren, Janet M. (Western Regional Hospital Board, Glasgow). pp 63-5 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5-7, 1966. See CONF-660561.

Levels of ^{90}Sr were estimated in diet and in urine for two age groups of children. In children aged 3 weeks-3 months with an all milk diet, the ratio $^{90}Sr(urine)/^{90}Sr(diet)$ had a mean value of 1.16 ± 0.21. For subjects between 2 and 13 years old on a mixed diet, the corresponding figure was 0.51 ± 0.15. (auth) (UK)

45587 STUDIES IN STRONTIUM METABOLISM. I. CORRELATION OF ^{90}Sr LEVELS IN FOETAL BONE AND MATERNAL DIET. Lenihan, J. M. A. (Western Regional Hospital Board, Glasgow). pp 57-61 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5-7, 1966. See CONF-660561.

Study of some 500 bone samples, from subjects in the Glasgow region in the age range 0 to 14 days, suggests that the concentration of ^{90}Sr in the bones of the newborn can be forecast from a knowledge of the concentration in milk forming part of the national diet at various periods up to 18 months before birth. Numerical coefficients that are proposed give close agreement between predicted and observed levels during the years 1961-65. (auth) (UK)

45588 PREDICTING ^{90}Sr CONCENTRATIONS IN HUMAN BONE. Rivera, Joseph (Atomic Energy Commission, New York). pp 47-55 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5-7, 1966. See CONF-660561.

An empirical relation between $^{90}Sr/Ca$ ratios in the human diet and resulting $^{90}Sr/Ca$ ratios in human bone is derived from observations of ^{90}Sr in vertebrae from accident victims of all ages, collected in New York City, Chicago and San Francisco since March, 1961, and from estimates of dietary ^{90}Sr made at these same cities on a trimesterly basis since March, 1960. The physiological significance of the age-dependent parameters involved in the empirical model are discussed, taking into account stable Sr concentrations found in diet and bone. (auth) (UK)

45589 ^{90}Sr FROM FALLOUT IN HUMAN BONE. Loutit, J. F. (Medical Research Council Radiobiological Research Unit, Harwell, Eng.). pp 41-5 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5-7, 1966. See CONF-660561.

Analyses of human bones were made by the U. K. Atomic Energy Authority continuously since 1956. From a review of their data and of observations by the Agricultural Research Council on the contamination of diet by ^{90}Sr, the rate at which bone loses its incorporated strontium was calculated. The rates vary according to age of subject. (auth) (UK)

45590 SOME PRINCIPLES OF STRONTIUM METABOLISM: IMPLICATIONS, APPLICATIONS, LIMITATIONS. Comar, C. L. (Cornell Univ., Ithaca, N. Y.). pp 17-31 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5-7, 1966. See CONF-660561.

Comparative metabolic behavior of calcium and strontium was studied, in order to provide a basis for evaluating and dealing with food chain contamination, as well as an understanding of governing processes. Headings are as follows: Sr-Ca relationships between precursors and products (precursor-product ratios, discrimination factors, discrimination and rate constants); changes in discrimination (effect of age on discrimination, OR(urine/diet) as related to urinary Ca); application to non-steady state systems; and current research. (UK)

45591 STUDIES ON THE INHIBITION OF RADIOSTRONTIUM UPTAKE FROM THE HUMAN GASTROINTESTINAL TRACT WITH SODIUM ALGINATE. Hesp, R.; Ramsbottom, B. (United Kingdom Atomic Energy Authority, Sellafield, Eng.). pp 313-21 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5-7, 1966. See CONF-660561.

Sodium alginate taken orally before, along with or after ingestion of tracer doses of ^{85}Sr inhibited the uptake of the tracer from the gastro-intestinal tract in two adult human subjects. (auth) (UK)

45592 MECHANISM OF CITRATE IN INFLUENCING THE EXCRETION OF RADIOACTIVE STRONTIUM. Smith, H. (United Kingdom Atomic Energy Authority, Chapelcross, Scotland). pp 323-8 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5-7, 1966. See CONF-660561.

Carrier-free ^{85}Sr was injected intra-arterially into rabbits. The rate of disappearance from the plasma was followed in animals with abnormally high concentrations of plasma citrate (maintained by continual injection of sodium citrate) and in control animals. (auth) (UK)

45593 EFFECTS OF METABOLIC INHIBITORS AND RADIATIONS ON REGENERATION IN THE CILIATE STENTOR COERULEUS. Burchill, Brower Rene. Cleveland, Western Reserve Univ., 1966. 142p.

Thesis.

Regenerating cells were either delayed or prevented from completing regeneration when exposed to solutions of Actinomycin D (2×10^{-4}M) in stages prior to Tartar's stage 5. Cells were not similarly affected by treatment with puromycin aminonucleoside (1.6×10^{-3}M) or hydroxyurea (5×10^{-3}M). Using autoradiography,

Actinomycin D and puromycin aminonucleoside were shown to inhibit 100% and 46%, respectively, of the RNA synthesis occurring during regeneration. Hydroxyurea was found to inhibit the incorporation of tritiated thymidine into material extractable with hot perchloric acid. However, this material can only tentatively be assumed to be DNA, since attempts to remove it with DNase were unsuccessful. Since ribosomal RNA synthesis was not required for regeneration (insensitivity to puromycin aminonucleoside) it was suggested that the essential RNA synthesis inhibited by Actinomycin D was messenger RNA (mRNA). Insensitivity to hydroxyurea would indicate that DNA synthesis was also not required for regeneration, if DNA synthesis was in fact inhibited. The effects of Actinomycin D and microsurgical emacronucleation on regeneration in Stentor were compared and the similarity of the results indicated that Actinomycin D might be having its primary effect by inhibition of macronuclear mRNA synthesis. Several pieces of circumstantial evidence led to the suggestion that the mRNA might be required for construction of the new ciliary membranelles of the cortical primordium. Regeneration was sensitive to both ultraviolet and gamma radiation. The dose-response of cells irradiated early in regeneration was approximately linear to both types of radiation. Combined doses of both types of radiation delayed the completion of regeneration more than either radiation dose alone. Irradiation during regeneration resulted in an increasing sensitivity early in regeneration to a maximum followed by a biphasic decline through the late stages. Ultraviolet and gamma radiation damage in cells irradiated prior to the initiation of regeneration was found to undergo a temperature sensitive dark-recovery. The magnitude of the temperature effect indicated that metabolic processes were involved. The effects of ultraviolet-irradiation were not photoreactivable. When cells were irradiated in stage late 4 and then placed in a solution of Actinomycin D (2×10^{-4}M) the completion of regeneration was delayed or prevented. This suggested a recovery process which requires RNA synthesis. The results of studies in which selected areas of the regenerating cell were irradiated with a microbeam of ultraviolet light (265 mμ) indicated that uv-induced regeneration delay was a result of macronuclear damage. A radiation-induced cytoplasmic toxin appeared to be involved since irradiation of non-nuclear, non-specialized areas of the cell did less frequently result in regeneration delay. Ultraviolet-irradiation during the early stages of regeneration may impair the normal functioning of the macronucleus in relation to its role in construction of the ciliary membranelles and irradiation later in regeneration, when the membranelles are completed, may damage some essential macronuclear function required for the completion of regeneration. (auth)

Ecology

Refer also to abstracts 45611 and 47030.

45594 (TID-23929) AN OUTLINE OF SOME ASPECTS OF ANIMAL POPULATION CONTROL. Eberhardt, L. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1967. 16p. (TAB-R-6). Dep. CFSTI.

Control of pest population after a disturbance in normal ecological conditions is discussed. Species-directed and system-directed approaches to the problem are considered. Control methods are evaluated for the following types of events: irruptive, invasive, vectorial, and oscillatory. Growth curves, death rate, response to control, and effects of competition and predation are treated mathematically. Difficulties in the analysis of the various models and concepts are shown. (W.E.B.)

Genetics and Cytogenetics

Refer also to abstracts 45505, 45834, 45843, and 45853.

45595 (ORNL-P-3322) HYBRID RESISTANCE TO PARENTAL GRAFTS OF HEMATOPOIETIC AND LYMPHOMA CELLS. Cudkowicz, Gustavo (Roswell Park Memorial Inst., Buffalo, N. Y. Dept. of Experimental Biology). [1967]. 55p. (CONF-670217-1). Dep. CFSTI.

From 21st Symposium on Fundamental Cancer Research, Houston, Tex.

A gene locus restricting expected compatibility of grafted homozygous parental hematopoietic cells in F1 hybrids was identified in linkage group IX of the mouse and designated Hybrid-histocompatibility-1 (Hh-1). The gene differed from ordinary histocompatibility genes (H) in three respects: one of its alleles was not co-dominant, it influenced specifically hematopoietic grafts, and it produced rejection by F1 heterozygotes and not necessarily by allogeneic Hh-1 homozygotes. For example, marrow cells homozygous for Hh-1^a—an allele shared by strains C57BL, C57L, 129, and LP—were rejected by heterozygous Hh-1^a/Hh-1^0 (C57BL × C3H)F1 hosts, but not by allogenic C3H mice homozygous for Hh-1^0, an allele possessed by most mouse strains. Other Hh genes or alleles generating this type of incompatibility occur and are being analyzed in strains DBA/2 and WB. Resistance conferred by Hh genes to heterozygotes, called hybrid resistance, can be viewed as a host control mechanism for the proliferation of grafted hematopoietic cells. It results from non-humoral, cell-mediated, specific destruction of the parental target cells. Hybrid resistance can be abrogated either by whole-body pre-irradiation of recipients, or by administration of killed Corynebacterium parvum (a maximal stimulant of the reticulo-endothelial system), or by induction of specific tolerance. Hybrids of appropriate genotype become resistant to parental grafts at the age of 20 days. Their resistance, once established, applies also to cells of C57BL/10 lymphomas homozygous for Hh-1^a. The marrow and lymphoma cells are capable, however, of optimal growth in susceptible F1 hybrids heterozygous at several H loci but not at the Hh-1 locus. Therefore, viability of grafted parental cells is not adversely affected by the presence of cellular alloantigens in the F1 host. It follows that immunogenetic and physiological properties distinguish hybrid resistance from other causes of deficient parental cell growth in F1 hosts, such as minor H alloantigens, stronger hybrid responses to tumor-specific or virus-associated antigens, or donor cell hypersensitivity. The manner in which resistant hybrids reject parental marrow grafts is indistinguishable from that in which inbred mice reject allogeneic marrow grafts. However, there are marked differences between rejection patterns of marrow and of skin allografts. (auth)

45596 THE EFFECT OF FAST AND INTERMEDIATE NEUTRONS ON THE CHROMOSOMES OF CREPIS CAPILLARIS. Shevchenko, V. V. (Inst. of General Genetic, Moscow). Genetika, No. 9, 40-8(1967). (In Russian).

The cytogenetic effect of 1.5 MeV fast neutrons and 200 KeV intermediate neutrons on the chromosomes of Crepis capillaris was studied. The 200 KeV intermediate neutrons radiation was characterized by the highest linear energy transfer (LET) among the types of radiations studied. Particular attention was paid to the qualitative effect of neutrons having different energy values. No considerable differences, either in the types and frequency of chromosomal rearrangements or in the radiosensitivity at different stages of the mitotic cycle were observed between the seeds and the seedlings of C. capillaris irradiated by an equal dose (50 rad) of neutrons with energies equal to 1.5 MeV (fast neutrons) and 200 KeV (intermediate neutrons). It was shown by the study of the distribution of chromosome breaks among different chromosomes in C. capillaris and of their localization along the chromosome arms in two types of aberrations (chromatid interchanges and isolocus breaks), that the breaks induced by neutrons with different LET values were characterized by a similar distribution, that differed from that of the breaks induced by sparsely ionizing agents (X-rays and protons of 120 MeV), only by a somewhat more even distribution of breaks along chromosome arms. (auth)

45597 THE EFFECT OF DIFFERENT DOSES OF GAMMA-RAYS AND CHEMICAL MUTAGENS ON WHEAT, BARLEY, AND PEA. Maslow, A. B.; Stepanova, N. D. (Principal Botanic Garden, Moscow). Genetika, No. 9, 27-34(1967). (In Russian).

Results of the comparative studies of the effect of γ rays and chemical mutagens on certain plants are described. Chemical mutagens were observed to be more active than γ rays. Ethylmethane sulfonate and ethylenimine proved to be the most efficient mutagens. In our experiments the best results were obtained when the following doses were used: wheat: ethylenimine (0.04), ethylmethane-sulfonate (0.1), γ-rays (7 kr), barley: ethylenimine (0.04), ethylmethane-sulfonate (0.2), γ-rays (10 kR), and peas: ethylenimine (0.02), ethylmethane-sulphonate (0.1), diethyl-sulfate, dimethyl-sulfate (3), γ-rays (7 kR). Some mutations interesting from the practical standpoint were obtained in the course of these studies. (auth)

45598 THE LETHAL AND MUTAGENIC EFFECTS OF ULTRAVIOLET RAYS ON KABATIELLA LINI (LAFF.) KARAK. AND PULLULARIA PULLULANS (DE BARY) BERNH. Levitin, M. M.; Zakharov, I. A. (Vavilov All-Union Research Inst. of Plant Protection, Leningrad. Ioffe Inst. of Physics and Tech., Leningrad). Genetika, No. 9, 65-70(1967). (In Russian).

A study was made of the lethal and mutagenic effects of ultraviolet radiation on the fungi Kabatiella lini (Laff.) Karak. (Polyspora lini Laff.) and Pullularia pullulans (De Bary) Berkh. No significant difference in their resistance to uv was observed. For all the strains the dose-survival curve was of a sigmoid type. $LD_{99.9}$ was about 37,000 erg/mm^2. Some mutants differing in their morphological and cultural characters and pigmentation were isolated. The homology of induced mutations was observed in

the strains studied. A correlation between the uv dose rate and the mutability of the character rough colony was characterized by a curve with a peak at a dose of 18,360 erg/mm². The maximal frequency of the occurrence of rough colony mutants was 1%. (auth)

45599 CERTAIN PRINCIPLES GOVERNING THE REPAIR OF CHROMOSOMES DAMAGED BY RADIATION IN HUMAN CELLS IN VITRO. Mokeeva, N. P. (Inst. of General Genetics, Moscow). Genetika, No. 9, 96-109(1967). (In Russian).

The principles governing the repair of chromosome damages were studied in a primary culture of human cells previously subjected to a fractionated irradiation consisting of two exposures to x-rays with an interval between them. The irradiations were carried out at different stages of the mitotic cycle. The frequency of each type of chromosome aberration changed depended on the duration of the intervals between the exposures. If the cells were irradiated at the stages G_1 and G_2, the character of these changes were as follows: at short intervals (10 to 30 minutes) a decrease in the level of aberrations was observed; at longer intervals (30 to 60 min.) the aberration frequency increased, attaining approximately the value in the control (where the total radiation dose was administered in a single exposure). When the cells were subjected to fractionated irradiation at the stage of DNA synthesis (stage S), the aberration frequency did not decrease. These results can not be explained from the standpoint of the classical theory of Sax and Lea. An interpretation based on the hypothesis of latent potential damages of chromosomes seems to be more justified. The latent damages induced by irradiation at the stage G_1 became apparent both during this stage of the cycle and during the beginning of the next stage S. In the cells irradiated at the stage S, most changes became apparent shortly after irradiation. In the cells irradiated at the stage G_2, the damages seemed to become apparent during the transition of the cells from this stage to mitosis. The recovery of the latent chromosome damages took place throughout the mitotic cycle. The efficiency of the recovery depended on the duration of the time elapsing from the moment of the irradiation to the moment when the damages became apparent. The activity of the repair system, that was responsible for the repair of any damages, began immediately after the irradiation. The function of the repair system depended on the status of the cell metabolism. Any temporary disturbance of the latter by irradiation resulted in the inactivation of the repair system, the degree of the inactivation depending on the stage of the mitotic cycle at which the cells were irradiated. (auth)

45600 CHROMOSOME DAMAGE AND OTHER CYTOLOGICAL EFFECTS. pp 383-483 of The Radiobiology of Cultured Mammalian Cells. Elkind, Mortimer M.; Whitmore, Gordon F. New York, Gordon and Breach Science Publishers, 1967.

The effects of radiation on various cell organelles, especially chromosomes, are discussed. Data derived from plant cells as well as mammalian cells are presented. The mechanism of chromosome breakage is discussed in reference to the effects of oxygen and temperature, the LET of the radiation used, the factors involved in restitution and rejoining, and the influence of cell age. The degree to which chromosome aberrations determine cell survival is discussed. (M.M.B.)

45601 VARIABILITY OF WESTERN EQUINE ENCEPHALOMYELITIS VIRUS. I. GENETIC MARKERS OF VIRUS VARIANTS OBTAINED BY FORMALDEHYDE TREATMENT AND ULTRAVIOLET IRRADIATION. Zasukhina, G. D.; Israelyan, A. A.; Levkovich, E. N. (Inst. of Poliomyelitis and Viral Encephalitides, Moscow). Acta Virol. (Prague) Engl. Ed., 11: 13-19(Jan. 1967).

Some virus mutants were produced by uv and formaldehyde treatment and were characterized in vitro and in vivo. Populations of Western equine encephalomyelitis (WEE) virus are heterogeneous with respect to the plaque size marker. The plaque size was affected by the conditions under which the virus was propagated and by the presence of protamine sulfate in the overlay medium. Large plaque variants were more virulent for mice on inoculation by the peripheral route and were more slowly inactivated by heating at 50°C than small plaque variants of the virus. Large and small plaque variants multiplied at 42°C in chick embryo cell (CEC) cultures, but multiplication of some large plaque variants was less intensive. Seven clones were obtained by uv irradiation of intracellular virus. CEC cultures inoculated at a multiplicity of one to two plaque-forming units per cell were irradiated 10 hr after inoculation by a BUF 30p lamp at a distance of 50 cm for 30 to 40 min. Variants apathogenic for mice, induced by formaldehyde, retained their apathogenicity and plaque size marker after addition of protamine sulfate; they were inactivated at 50°C more rapidly than the pathogenic variants. Large plaque variants obtained by uv irradiation had genetic characteristics approaching those of large plaque variants isolated from the virus population. (BBB)

45602 VARIABILITY IN ASPERGILLUS NIGER INDYCED BY THE COMBINED EFFECT OF ETHYLENIMINE AND ULTRAVIOLET IRRADIATION. Imshenetskii, A. A.; Kuzyurina, L. A. (Inst. of Microbiology, Moscow). Microbiology (USSR) (Engl. Transl.), 35: 688-91(Sept.-Oct. 1966).

Mutants induced by ethylenimine (EI) and uv light, with particular attention to those producing increased quantities of citric acid, were sought. When plated out, the original strain in A. niger (6/5) not treated with mutagens did not form cultures with increased capacity to produce citric acid. Relatively low doses of EI induced mutants producing more citric acid than the initial cultures. High EI doses led to the appearance of mutants with a decreased citric acid-producing capacity. Combined treatment with EI and uv gave mutants which were more active than those obtained by treatment by either mutagen separately. These active cultures were encountered very rarely among mutants possessing yellow, green, or brown pigmentation. Active mutants were most frequently characterized by smaller colony size and less abundant conidial formation than in the original strain. Mutants unable to grow on sucrose-mineral medium did not occur after treatment with EI alone for 30 or 45 min, but with the same EI doses in combination with uv the formation of mutants unable to develop on sucrose-mineral medium was always noted. Hence, the combination of the two mutagens led to qualitatively different results from that obtained by using the same mutagens separately. (BBB)

45603 ULTRAVIOLET-SENSITIVE MUTANTS IN NEUROSPORA CRASSA. Chang, Lung-ting; Tuveson, R. W. (Univ. of Chicago). Genetics, 56: 801-10(Aug. 1967).

Two ultraviolet-sensitive mutants, UVS-1 and UVS-2, have been isolated from a microconidial strain. In contrast to the shouldered survival curves for conidia of parental microconidial strains, UVS-1 exhibits strictly exponential kinetics of uv inactivation, whereas UVS-2 retains a short shoulder in its survival curve. Both mutants are cross-sensitive to sodium nitrite ($NaNO_2$). UVS-1 was also tested against N-methyl-N′-nitro-N-nitrosoguanidine and is more sensitive than the strain from which it was derived. A heterokaryon test and tetrad analysis clearly indicate that the sensitivity of UVS-1 resulted from the alteration of a single nuclear gene. In contrast, the sensitivity of UVS-2 seems to be non-nuclear in origin. Crosses homozygous for uvs-1 had no effect on crossing over between the linked genes rg and mt, although the development of asci and ascospores was affected. (auth)

45604 RADIOSENSITIVITY OF VARIOUS PHASES OF THE CELL DIVISION CYCLE IN TUMOR CELLS. Maass, Heinrich; Schulz, Klaus-Dieter (Univ., Hamburg). Strahlentherapie, Sonderbaende, 64: 193-6(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18-21, 1966. See CONF-660566.

Reactions propagating DNA synthesis are probably more sensitive to x radiation and alklyzing cytostatics than any other agents. Cell division is inhibited as a result of a later G_2 block and mitosis cannot start. Published results show that, with respect to lethal damage, possibly the S phase is the most sensitive since chromosome aberrations accumulate. (tr-auth)

45605 EFFICIENCY DIFFERENCE OF 14.2 MeV ELECTRONS AND 200 kV X RADIATION ON UNDIFFERENTIATED DIVISION TISSUE. Markus, Benno; Schuettrumpf, E. (Univ., Goettingen, Ger.). Strahlentherapie, Sonderbaende, 64: 203-8 (1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18-21, 1966. See CONF-660566.

A study was made to derive from experiments with root tips of Allium sepa, a contribution to the question of the elective effect of fast electrons in radiotherapy. With equivalent doses of 350 and 260 R (electron and x radiation, respectively) administered with special precautions on the control of the object dose and preservation of the physiologically undisturbed state, a mitosis inhibition of more than 50% was obtained in the minimum mitosis rate at six hours post irradiation. The complete time pattern of the mitosis rate before and after irradiation during the observation time interval up to 39 hours was in complete quantitative agreement for both types of radiation. The mitosis rate had returned to normal by the end of the observation interval. The simultaneous observation of the relative frequency of chromosome aberrations in the anaphase cells and telephase cells showed, during the total observation interval, which comprised several cell generations, a very clear effect of the x radiation. The results are reported and discussed. (tr-auth)

45606 (COMPARATIVE INVESTIGATIONS ON CHROMOSOME MUTATIONS OF HUMAN LEUCOCYTES BY X RAYS AND TRIETHYLENEMELAMINE. Hampel, K.-E.; Balig, W. (Freie Univ., Berlin). Strahlentherapie, Sonderbaende, 64: 245-51(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

The effect of x radiation on human leucocytes in vitro was compared with the effects of triethylenemelamine treatment under comparable research conditions. The results showed that both mutagenic agents induce qualitatively similar chromosome aberrations and display a similar dose dependence. After x irradiation the breaks were distributed uniformly over the chromatid segments. The break localization after triethylenemelamine increased from proximo to distal in frequency. (J.S.R.)

45607 RELATION BETWEEN THE X-RAY DOSE AND THE RATE OF CHROMOSOME REARRANGEMENTS IN SPERMATOGONIA OF MICE. Leonard, A.; Deknudt, Gh. (Centre d'Etudes de l'Energie Nucleaire, Mol, Belg.). Radiat. Res., 32: 35–41 (Sept. 1967).

Male mice from the BALB/c strain were irradiated with increasing doses of x-radiation. Ten weeks after the treatment, meiotic preparations from the testes were made by an air-drying technique. The reciprocal translocation was the most frequent chromosome rearrangement seen. No relation was found between the nature of the rearrangements and the x-ray dose. The relationship between the x-ray dose and the rate of abnormal cells appears to be linear with a regression coefficient b = 0.017121 ± 0.001048. (auth)

45608 ESTABLISHING THE HEREDITARY CHANGES AND CERTAIN PHYSIOLOGICAL AND BIOCHEMICAL CHANGES IN THE PROGENIES OF RABBITS TREATED WITH RADIOACTIVE ^{131}I. Konstantinov, G.; Eftimov, B.; Aleksiev, D. (Georgi Dimitrov Higher Agricultural Inst., Sofia). Compt. Rend. Acad. Bulg. Sci., 20: 485-7(1967).

Radiation effects of ^{131}I were studied in a series of matings of thoroughbred rabbits of the Belgian Giant, Chinchilla, and Vienna Blue breeds. Both sex and somatic aberrations were noted, with hematopoiesis showing the greatest effects. Following treatment with five and ten μCi of ^{131}I, two mating plans were devised to obtain F_1, F_2, R_1, $R_1 \times R_1$, $F_1 \times R_1$, and $F_2 \times R_1$ generations. In both mating plans, 50% of the specimens obtained from treated rabbits died either immediately or within six months after birth. Sexual reflexes and reproductive capacities were disturbed in the treated animals used in mating. Spermatozoa counts dropped 50% and motility of spermatozoa decreased up to 30%. Only half of the treated animals yielded progeny in the first generation. At the end of the two mating series, those animals surviving the high mortality rate were subjected to physiological and biochemical investigations. Results of these investigations indicated a rise in catalase content, erythrocyte count, and hemoglobin content of the blood. A temporary drop in leucocyte count was noted. Changes in the spermatozoa count and γ globulin content of the seminal fluids of animals in all generations were also noted. Phenotypic changes were prevalent among the progeny, with albinoses occurring frequently. (E.R.B.)

45609 EFFECTS OF X-RAYS, TRYPTOPHAN METABOLITES, AND EYE COLOR MUTANTS ON THE TUMOR-SUPPRESSOR SYSTEM IN DROSOPHILA MELANOGASTER. Brooks, Gretchen Terhune. Columbus, Ohio, Ohio State Univ., 1966. 135p.

Thesis.

Four stocks of Drosophila melanogaster incorporating different combinations of tumor alleles on the second chromosome and tumor-suppressor alleles on the third chromosome were submitted to 1000 R of x rays, dietary manipulations, and mutant eye color gene substitutions in order to test the influence of x ray action and tryptophan metabolism on the induction of melanotic tumors in third-instar larvae. There was no significant difference between tumor incidence resulting from x ray treatment in air and that resulting from x ray treatment in 100% O_2; but both treatments produced a significant increase in tumor penetrance over control incidence for each of the four parent stocks: suppressor-erupt (tu;su-tu), al b c sp^2 (tu^+; su-tu^+), tumor (tu; su-tu^+), and erupt (tu^{er}; su-tu). Comparisons of tumor incidence in parent stocks, F_1 progenies, and certain backcross progenies revealed the existence of effective isoalleles of varying potency at both the tumor and tumor-suppressor loci. The tu^+ and su-tu^+ alleles, previously assumed to be ineffective wild-type alleles, are, in actuality, weakly effective alleles. The results indicate that a dominance relationship exists among the three tumor alleles such that the order of dominance is $tu^+ > tu^{er} > tu$, while the effectiveness in producing the tumor phenotype is just the reverse: $tu > tu^{er} > tu^+$. Of the two suppressor alleles, su-tu^+ seems to be dominant over su-tu, which is a much stronger suppressor than the former. The su-tu allele appears to act as a recessive in the presence of homozygous tu, while the su-tu/su-tu^+ combination is quite effective in suppressing the tumor phenotype produced by weaker tumor allele combinations. The increase in tumor incidence following x ray treatment is attributed to a dual action of x rays: enhancement of the expression of the tumor gene and inhibition of the expression of the tumor-suppressor gene. It was further postulated that x ray action has a differential effect according to the potency of alleles present at the two loci. The supplementary feeding of excess amounts of the tryptophan metabolites, anthranilic acid, xanthurenic acid, or DL-kynurenine, to larvae resulted in an increase in tumor penetrance in the four parent stocks, although the concentration required to produce the increase varied for the different stocks, presumably because of differences in tumor and tumor-suppressor alleles. Kynurenine dissolved in phosphate buffer (pH 7.0) was far more effective than the unbuffered compound, perhaps because the buffered form is more readily utilized. Feeding of quinolinic acid or 3-hydroxyanthranilic acid was effective in producing a decrease in tumor penetrance. The insertion of the vermilion eye color mutant, which blocks the first reaction in the stepwise conversion of tryptophan to brown eye pigments, into the suppressor-erupt stock resulted in a decrease in tumor penetrance, while an increase in tumor incidence was observed in tumor stock flies carrying vermilion. A scheme was proposed whereby excess amounts of intermediate compounds occurring in the first part of the tryptophan pathway were postulated to produce a feedback effect resulting in the accumulation of tryptophan, which also occurs in the presence of the vermilion metabolic block. This accumulation would then make tryptophan available for tumor formation via an unknown pathway. Quinolinic acid and 3-hydroxyanthranilic acid, which occur near the end of the metabolic conversion of tryptophan, were postulated to act as, or to enhance the action of, suppressors of the tumor phenotype. The scarlet eye color mutant, which produces a block in this end of the pathway, was also proposed to have a suppressor effect on tumor incidence. (Disser. Abstr.)

Health Physics and Safety

Refer also to abstracts 45180, 45187, 45233, 45246, 45338–45340, 45527, 45588, 45589, 45761, 46880, and 47050.

45610 (AD-649385) RADIATION MONITORING WITH NUCLEAR EMULSIONS ON PROJECT GEMINI II: RESULTS ON THE 14-DAY MISSION GEMINI VII. Schaefer, Hermann; Sullivan, Jeremiah J. (Naval Aerospace Medical Inst., Pensacola, Fla.). Jan. 11, 1967. 21p. (NAMI-990). CFSTI.

Small nuclear emulsion packs worn by the astronauts at three locations inside their space suits were evaluated by track, grain, and enders count for evaluation of LET spectrum and absorbed dose. By using G.5/K.2 emulsion pairs, a sustained resolution over the entire LET scale of protons from zero to relativistic energies was obtained. It was found that the energy dissipation centers heavily on low energies, with 40% of the absorbed dose due to protons of less than 0.1 g/sq cm residual range. Total proton doses at the six locations (left and right chest, thigh pocket of each astronaut) varied from 159 to 233 millirads. The enders count was found to vary by as much as a factor of 1.35 within the same 1 by $1\frac{1}{2}$-inch film sheet, indicating that the radiation field within the vehicle not only varies over distances comparable to body size, but also reflects local inhomogeneities of shielding conditions on a centimeter and millimeter scale. (auth) (TAB)

45611 (CONF-670724–1) RADIATION SURVEILLANCE IN WILDLIFE. Engel, Ronald E.; Brechbill, Raymond A. (Public Health Service, Las Vegas, Nev. Southwestern Radiological Health Lab.). [1967]. 5p. Dep. CFSTI.

From Conference of Western Association of Fish and Game Commissioners, Honolulu, Hawaii.

A report on the wildlife surveillance activities in the Nevada Test Site environs is presented. The purpose of the study is fourfold, and includes: maintenance of veterinary public relations with the off-site population, investigation of alleged damage to domestic animals from AEC activities, determination of the tissue concentration of fission products in samples obtained from bovines on off-site ranches, University of Nevada Experimental Station and the Nevada Test Site, and development and conduction of wild life studies on and near the Nevada Test Site to assess radionuclide content of edible wildlife species. In connection with this fourfold study, a study of the fission product accumulation of the Nevada Test Site mule deer was initiated. Background levels of radioisotopes in the desert bighorn sheep ranging in the Nevada Test Site were also determined. Beginning in July 1965, a survey of the ^{90}Sr content of the hock joints in

wildlife ruminants was conducted under the assumption that these samples would serve as biological dosimeters from which fallout could be determined. A cooperative mule deer food habit analysis study is currently being conducted with various agencies in the area. Hock joints and thyroids are analysed in this study, the former for ^{90}Sr, the latter for ^{131}I. Here again, the thyroid was used as a biological dosimeter for ^{131}I in that portion of the state. The migration routes of the mourning dove are the object of intense investigation in the test site area. Trap mortalities are utilized to access radioisotope content in these birds. (E.R.B.)

45612 (HASL-183(App.)) FALLOUT PROGRAM. Quarterly Summary Report, June 1, 1967-September 1, 1967. Appendix. (New York Operations Office (AEC), N. Y. Health and Safety Lab.). Oct. 1, 1967. 202p. Dep. CFSTI.

STRONTIUM-89—deposition from fallout at various world land sites from 1961 to March, 1967
STRONTIUM-90—deposition from fallout at various world land sites from 1956 to March, 1967
FALLOUT—monitoring at various world sites from 1956 to March 1967
FALLOUT—radioisotopes collected at various sites in U.S. from 1962 through 1966
ATMOSPHERIC PRECIPITATION—fallout in, collected at various sites in U.S. from 1962 to March, 1967
MANGANESE-54—content in precipitation in U.S. from 1962 to 1967
IRON-55—content in precipitation in U.S. from 1962 to 1967
STRONTIUM-89—content in precipitation in U.S. from 1957 to April, 1967
STRONTIUM-90—content in precipitation in U.S. from 1961 to April, 1967
ZIRCONIUM-95—content in precipitation in U.S. from 1961 to April, 1967
RHODIUM-102—content in precipitation in U.S. from 1960 to 1965
RUTHENIUM-103—content in precipitation in U.S. from 1961 to 1964
RUTHENIUM-106—content in precipitation in U.S. from 1960 to 1964
CADMIUM-109—content in precipitation in U.S. from 1964 to March, 1967
ANTIMONY-124—content of atmospheric precipitation in U.S. from 1962 to 1965
ANTIMONY-125—content of atmospheric precipitation in U.S. during 1963 and 1964
CESIUM-137—content of atmospheric precipitation in U.S. from 1961 through 1966
BARIUM-140—content of atmospheric precipitation in U.S. from 1958 through 1964
CERIUM-141—content of atmospheric precipitation in U.S. from 1961 through March, 1967
CERIUM-144—content of atmospheric precipitation in U.S. from 1960 through March, 1967
PLUTONIUM-238, PLUTONIUM-239—content of atmospheric precipitation in U.S. from 1964 through March, 1967
ATLANTIC OCEAN—strontium-90 content of atmospheric precipitation in, from 1965 through February, 1967
STRONTIUM-90—content of atmospheric precipitation in Atlantic Ocean from 1965 through February, 1967
MILK—strontium-90 content of, in New York City from 1954 through 1966
WATER SUPPLIES—strontium-90 content of, in New York City, from 1954 through April, 1967
WATER SUPPLIES—cesium-137 content of, in New York City, from 1965 through April, 1967
STRONTIUM-90—content of milk in New York City from 1954 through April 1967
CESIUM-137—content of water supplies in New York City from 1965 through April, 1967
CONSTANTS AND CONVERSION FACTORS—use in fallout sampling (C.H.)

45613 (NP-16900) DATA FROM RADIATION PROTECTION PROGRAMS. Volume 5, Number 4. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.). Apr. 1967. 46p. Dep.

Four papers on radiation protection in the Canadian north are presented with tables and graphs and numerical data. Individual abstracts were prepared for each paper. (L.C.L.)

For abstracts of individual papers see: 45233 and 45614-45616.

45614 (NP-16900, pp 3-13) ^{137}Cs IN THE CANADIAN NORTH. Burchell, J. D.; Gordon, J. H.; Downs, A. A. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.).

The cesium-137 content in caribou, moose, and reindeer meat samples, in fish and meat samples purchased in local stores, and in the urine of Eskimos in northern Canada were measured in 1966. The results are tabulated. (L.C.L.)

45615 (NP-16900, pp 14-27) RADIATION PROTECTION DIVISION RESULTS IN THE 1964 INTERLABORATORY COMPARISON PROGRAM OF THE INTERNATIONAL ATOMIC ENERGY AGENCY. Welsh, W. J.; Samuels, E. R. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.).

The results of a 1964 and 1965 interlaboratory study conducted by the IAEA to determine the ^{137}Cs and ^{90}Sr content in meat ash, fish meal, and powdered milk, and the ^{90}Sr content in bone ash, rice flour, and soil are presented. (L.C.L.)

45616 (NP-16900, pp 35-44) REACTOR ENVIRONMENT MONITORING FOR MARCH 1967. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.).

The results of environmental monitoring near Canadian reactors during March 1967 are tabulated. (L.C.L.)

45617 (ORAU-101, pp 70-3) DOSIMETRY USED IN EQUATING VARIOUS RADIATION EXPOSURES FOR DETERMINING DOSE-RESPONSE RELATIONSHIPS. Beck, William L. Jr.; Cloutier, R.; Comas, Frank V. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

The factors that can affect retrospective determinations of radiation dose response in man are discussed. Results are reported from calculations of the radiation dose from single and fractionated exposure to γ; whole-body exposure to γ; accidental exposure to mixed γ and neutrons; whole-body exposure to x radiation; and dosimetry studies in a plexiglass phantom using an aqueous ferrous sulfate solution. (C.H.)

45618 (ORAU-101, pp 117-19) A TWO-YEAR STUDY OF ^{137}Cs AND POTASSIUM IN NORMAL SUBJECTS. Gibbs, William D.; Hodges, H. D.; Lushbaugh, C. C.; Quarles, J. F. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

Data are presented on the content of ^{137}Cs and K in normal persons as determined by whole-body counting during 1965 and 1966. Whole-body K content was calculated from measurements of whole-body ^{40}K content. The mean whole-body ^{137}Cs content of both men and women was lower in 1966 than in 1965. (C.H.)

45619 (ORNL-4146) HEALTH PHYSICS AND SAFETY ANNUAL REPORT FOR 1966. (Oak Ridge National Lab., Tenn.). Aug. 1967. Contract W-7405-eng-26. 88p. Dep. CFSTI.

Separate abstracts were prepared for the six technical information sections included in the report. (J.R.D.)

For abstracts of individual sections see: 45249, 45371, and 45620-45623.

45620 (ORNL-4146, pp 36-55) PERSONNEL MONITORING. (Oak Ridge National Lab., Tenn.).

Data and information are included on personnel dose analysis, external dose techniques, internal dose techniques, records and reports, and program developments. (J.R.D.)

45621 (ORNL-4146, pp 56-62) LABORATORY OPERATIONS MONITORING. (Oak Ridge National Lab., Tenn.).

Data and information are presented concerning unusual laboratory occurrences, radiation surveys, laundry monitoring, and solutions to problems at various plant installations. (J.R.D.)

45622 (ORNL-4146, pp 63-72) INDUSTRIAL SAFETY. (Oak Ridge National Lab., Tenn.).

Data and information are included concerning accident analyses and analyses of disabling injuries. (J.R.D.)

45623 (ORNL-4146, pp 73-7) LABORATORY ASSAYS. (Oak Ridge National Lab., Tenn.).

Data and information are included on bio-assay analyses, counting facility processing, autoradiography, and whole body counting. (J.R.D.)

45624 (ORNL-NSIC-38) COMPILATION OF NATIONAL AND INTERNATIONAL NUCLEAR STANDARDS (EXCLUDING U. S. ACTIVITIES). 3rd Edition, 1967. (Oak Ridge National Lab., Tenn.). Oct. 1967. Contract W-7405-eng-26. 50p. Dep. CFSTI.

Countries and international organizations which have reported nuclear standards activities are listed, and the activities are described. (D.C.C.)

45625 (RFP-954) MEASUREMENTS OF ^{238}Pu. Mann, John R.; Bistline, Robert W.; Johnson, Valens P. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). June 30, 1967. Contract AT(29-1)-1106. 7p. Dep. CFSTI.

Evaluation was completed of detectors in use at Rocky Flats for determining detectable plutonium amounts in the body. Specifically, the study included sample measurements of plutonium 238, in vivo, with a scintillation spectrometer detector. The findings, using a phantom chest model, showed that four times the maximum permissible lung burden was the minimum that could be detected. The minimum detectable amounts in the liver were less than one permissible liver burden. (auth)

45626 (RRA–T71) CALCULATED GAMMA-RAY DOSE DISTRIBUTIONS IN A PHANTOM EXPOSED TO FALLOUT AND SIMULATED FALLOUT. French, R. L.; Tompkins, K. W.; Garrett, C. W. (Radiation Research Associates, Inc., Fort Worth, Tex.). Feb. 1967. Contract DA-49-146-XZ-479. 69p. (AFRRI-CR-67-1). CFSTI.

Gamma-ray depth-dose distributions in a phantom exposed to fallout and to simulated fallout were calculated by the Monte Carlo method. The phantom consisted of a tissue equivalent vertical right cylinder of 60 cm height and 30 cm in diameter. The center of the phantom was 3 ft 8 in. (111.8 cm) above a smooth ground surface uniformly contaminated with ^{235}U fission products. The energy and angle distribution of the gamma rays incident upon the phantom were taken from previous Monte Carlo calculations. The depth-dose distributions were found to be relatively insensitive to fallout age over the period investigated (1 hour to 9 days). The dose rate at the center of the phantom was approximately 65 percent of the free-field dose rate, while that at the lateral surface was approximately 80 percent. Except near the extremities, the dose rate along the vertical axis of the phantom varied at approximately the same rate with height above ground as did the free-field dose rate. Approximately one-half of the dose rate at the center of the phantom was from photons that had suffered previous collisions in the phantom. The depth-dose distributions were calculated for two arrangements of artificial sources which, although not duplicating the fallout energy spectra, were intended to produce similar depth-dose distributions. The patterns produced by revolving the phantom on its vertical axis while exposed to a point ^{60}Co source at a horizontal distance of 200 ft were similar to those from the fallout, except for internal positions near the bottom of the phantom. A special arrangement of ^{60}Co, ^{137}Cs, and ^{144}Ce sources produced substantially the same depth-dose patterns throughout the phantom as did the fallout. An additional calculation was performed of the depth-dose distribution within a phantom positioned at the center of a 4 ft diameter by 5 ft deep foxhole located in a 1.12-hr fallout field. The distribution in the horizontal midplane of the phantom was found to be quite similar in shape to the above ground case except for a sharper dropoff of the dose away from the lateral surface. As would be expected, however, the axial distribution was quite different from that found above ground. (auth)

45627 (WASH–1076, pp 28-34) TECHNICAL REQUIREMENTS FOR NUCLEAR SAFEGUARDS. Taylor, Theodore B. (Defense Atomic Support Agency, Washington, D. C.).

The need for nuclear safeguards is discussed and basic requirements for international or national safeguards systems are considered. The development and use of an information collection, storage, manipulation, and retrieval system that can keep track of all the parameters that define the past, present, and future state of the worlds' nuclear energy system are discussed. Techniques for describing a safeguards system on paper or in electronic data-storage units and for analysis of the effectiveness of specific safeguard-system concepts are shown to be necessary. A fuel-element isotopic-content scanning and tracking system is proposed. (M.C.G.)

45628 (WASH–1076, pp 44-50) NUCLEAR MATERIALS CONTROL SYSTEMS STUDIES. Kinderman, E. M. (Stanford Research Inst., Menlo Park, Calif.).

A summary of the current practice and future requirements of the U. S. nuclear-materials control system is presented along with a review of some systems research. Development of a model of a complete national or international safeguards system for evaluation of possible losses is considered. (M.C.G.)

45629 DOSE FIELDS OF ^{60}Co GAMMA RADIATION IN SURFACE LAYERS OF TISSUE-EQUIVALENT SUBSTANCE. Krongauz, A. N.; Kolotilova, V. G.; Lyapidevskii, V. K.; Pavlova, T. G.; Titov, A. A. (Research Inst. of Roentgen-Radiology, Moscow). Med. Radiol., 12: No. 7, 9-14(July 1967). (In Russian).

Experimental studies were made of the distribution of absorbed doses of ^{60}Co γ radiation in surface layers of a plexiglass phantom with the aid of scintillation and transistorized detectors. Calibration of detectors was performed by the ionization dosimeter in identical conditions of irradiation. The distribution of depth absorbed doses depending on the value of the irradiation field is described. (auth)

45630 CHEMICAL DOSIMETRY OF X RAY RADIATION IN A RADIOBIOLOGICAL EXPERIMENT. Vakhlakova, T. V.; Plotnikov, G. S. Med. Radiol., 12: No. 7, 47-52(July 1967). (In Russian).

Ferrosulfate chemical dosimetry of x radiation was satisfactory for determining the absorbed doses on the surface of the irradiated object. The mean error of one determination did not exceed ±3.0%. This was established as the result of elucidating the character of energy weakening during passage through the dosimetric system, and elaboration of the curve diagram of the dependence between the absorbed dose power, the thickness of the dosimetric solution layer, and interpolation of this curve on the zero surface. The mean doses of irradiated objects were determined by using models with dosimetric solution and by the percentage calculation of the dose ratio obtained in experiment. It was shown that the time spent on dosimetry of roentgen radiation, with the aid of the modified ferrosulfate system, is 10 times less than with the use of the standard method. (auth)

45631 METHOD OF MEASURING BETA-ACTIVE PREPARATIONS WITH THE AID OF END-WINDOW COUNTERS. Yagovoi, P. N. Med. Radiol., 12: No. 7, 68-73(July 1967). (In Russian).

A method is described for determining the coefficients of transition from impulses to counts in measuring beta active preparations on end-window counters. The calculation of coefficients is based on the utilization of the experimentally obtained ^{40}K scheme of dependence between the value of the impulse and weighted amount of the substance in the preparation. By means of this method one could determine the radioactivity when there is one isotope in the preparation having one or two spectra of beta-radiation; or when there are two isotopes, each having one spectrum of beta-radiation energy. (auth)

45632 DISCUSSION OF FACTORS PROMOTING THE RADIOACTIVE CONTAMINATION OF CULTIVATED CROPS. Bittel, R. (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Ann. Agron., Hors-Ser., 16: 265-86(1965). (In French).

Plants take-up from the biosphere radioactive elements originating from radioactive fall-out and irrigation water. The mechanisms of absorption are the same as those operating for stable elements in mineral nutrition. Similarly to the uptake of elements from the soil by way of roots or by the aerial organs, plants may become contaminated indirectly from the soil by way of their roots or directly by absorbing radioactive elements deposited on their leaves, flowers and fruits. Due to the colloid complex, radioactivity accumulates in soil; there is a trend towards an equilibrium between radioactive additions and loss in radioactivity by leaching to the subsoil and uptake by roots. When the radioactivity of the soil reaches the limit value R, plants assume an R' value that is proportional to R. Equilibrium is rapidly reached with radioactive elements of small and medium half-life, but is reached very much slower with the long-lived isotopes of such as caesium-137 and strontium-90. These two elements are mainly considered. The R' values may reach dangerous levels if the plants are grown on soils of low exchange capacity, on acid soils, or on soils in which a superficial development of the root system renders contamination through the water supply more likely. The hazard of indirect contamination is highest with strontium-90. Direct contamination does not show the cumulative nature of indirect contamination; it mainly depends on the conditions of water supply and on the properties of the aerial organs. Cereals may undergo heavy contamination by fixation on the tissues enveloping the flowers, while many legumes with well developed aerial organs may retain part of the radioactivity supplied by rain or irrigation water. Cultural technics such as method of irrigation and measures taken for economizing with water are important factors in contamination. A preliminary, and probably incomplete, inventory of "critical" crops includes a large number of plants, the organs of which serve for human alimentation, such as many vegetable crops (cauliflower, lettuce, spinach, tomato), potato, bean and some fruits (pear, apricot, peach, strawberry, and possibly grapes and apple). (auth)

45633 THE CONTROL OF THE CONTAMINATION OF SURFACES WITH TRITIUM OXIDES AND DEACTIVATION MEASURES. Istomina, A. G.; Shtukkenberg, Yu. M. Med. Radiol., 12: No. 7, 61-7(July 1967). (In Russian).

The contamination of six different materials by tritium oxides is reported. A method is proposed for the measurement of the contamination of surfaces and an assessment is given of decontamination methods for surfaces polluted by tritium oxides. (auth)

45634 A METHOD OF ASSESSING THE EXTENT OF RADIATION HAZARDS WITH SIMULTANEOUS PRESENCE OF THE DAUGHTER PRODUCTS OF RADON AND THORON IN THE AIR. Gusarov, I. I. Gig. Sanit., No. 4, 68-71(Apr. 1967). (In Russian).

A method is suggested for determining the combined latent energy of thoron and radon daughter products present in the air. The curve of the α activity of the thoron and radon daughter product in the air filter during filtration and following 6 hr of filtration showed that the α-activity increased during the filtration time. Correlations of the suggested approximate and accurate method of calculations of the total α energy of the radon and thoron daughter products separated from 1 l of air are tabulated. The results indicated that the maximum permissible level was approximately 5000 α-decays per liter of air or latent α-radiation energy in 1 l of air of 3.8×10^4 MeV per liter of air. (R.V.J.)

45635 DOSES SCATTERED FROM A PHANTOM IRRADIATED WITH 80 TO 200 kV X-RAYS AND ^{60}Co γ-RAYS. Kuroda, Yoshikazu; Nbuya, Koichiro (Tokyo Jikei-kai School of Medicine). Jikeikai Med. J., 80: 528-30(Jan. 1966). (In Japanese).

The scattered radiation doses from a phantom (patient) irradiated with x rays of various energies and ^{60}Co γ rays, which are actually used in the radiotherapy, were measured. The irradiation fields were 5 × 5 cm, 10 × 10 cm, and 15 × 15 cm; the radiations were x rays of 80, 120, 150, and 200 kV, and ^{60}Co γ rays; the distance from the center on the incidence face to the measuring point was 100 cm; the measuring directions were 45° and 90°; and the phantom was a water one. The results showed that the scattered doses in the direction of 90° were 1.3 to 1.6 times as large as those for 45°. This is thought to be due to the radiation absorption in the thickness of the phantom. In the case of x irradiations, the scattered doses increased with the increasing energy for all the fields. In the field of 5 × 5 cm, the doses for ^{60}Co γ rays were larger than those of 200 kV x rays, but when the field area was increased to 10 × 10 cm and 15 × 15 cm, the doses for 200-kV x rays became larger than those of the γ rays. In the irradiations with 80 to 200 kV x rays, the lower the x ray energy, the more rapid was the dose increase with the increasing field-area. In the case of ^{60}Co γ rays, the increase of scattered doses with the increasing field area was not large, compared with the x rays. (NSA of Japan)

45636 MITOGENETIC RADIATION. Metcalf, W. S. (Univ. of Canterbury, Christchurch, New Zealand); Quickenden, T. I. Nature (London), 216: 169-70(Oct. 14, 1967).

Mitogenetic radiation, usually considered to be UV in nature, is a radiation emitted by dividing cells and which stimulates the division of other cells. Earlier studies proved to be of a negative character. With increase in the sensitivity of photon counters and modern equipment, the detection of radiation from yeast and tissue cultures has been claimed, and the present communication describes an attempt to check measurements made. It has been stated that a solution comprised of 2 drops of 6% oxalic acid added to 3ml. of 0.2% $KMnO_4$ emits radiation of intensity similar to mitogenetic radiation, and this was employed as a reference solution. The photon counter employed readily measured light in the range 2000 to 6000 Å from this solution. Experimental details are described. Suspensions of yeast or bacteria in their rapidly dividing logarithmic phase of growth were suspended in a nutrient medium of, say, trypticase broth, which emitted detectable phosphorescence for up to 5 min. After this period no light could be detected from any of the suspensions examined. It is concluded that any radiation from the growing cells must have been less than one-fifth of that from the reference solution. (UK)

45637 THE "INERTNESS" OF LiF. Dettmer, C. M.; Galkin, B. M.; Hanna, H. J. (Jefferson Medical Center, Philadelphia). Phys. Med. Biol., 12: 577-8(Oct. 1967).

It is stated that in the rapidly developing use of LiF as a thermoluminescent dosimeter there has arisen a possible misconception that TLD LiF is inert, insoluble, and non-toxic. In a preliminary study in which the drinking water of young rats was saturated with the LiF powder, 100% fatality occurred. This prompted a larger study in which rats were exposed to the following: (1) drinking water saturated with the powder; (2) LiF powder surgically placed in the peritoneal cavity; and (3) powder instilled into the stomach via a gastric tube. There was a marked weight loss, and the animals became lethargic, irritable, and developed gross tremors. The stomachs were found to be hypertrophied and hyperemic on autopsy, findings which are consistent with pharmacological descriptions of fluoride ingestion. Other findings included multiple adhesions from the abdominal wall to omentum and visceral peritoneal surfaces, together with small granulamatous type lesions, associated with abscess formation. The results appear to indicate that dosimetry grade LiF powders should be used with as much caution as other toxic fluorides. (UK)

45638 PROSPECTS FOR THE MANUFACTURE OF CHEESE FIT FOR HUMAN CONSUMPTION FROM MILK CONTAMINATED WITH RADIOACTIVE NUCLEAR FISSION PRODUCTS. de Ruig, W. G. (Government Dairy Station, Leiden). Neth. Milk Dairy J., 20: 283-95(1966).

In case of atmospheric nuclear explosions, milk and milk products could be heavily contaminated with radioactive fission products, of which ^{90}Sr is the most dangerous for human beings. Methods are described for manufacturing a fairly acceptable whole cheese with a low contamination-level. The ^{90}Sr content of cheese can be reduced to one tenth of that of a normal Gouda cheese by modifying the processing in the following ways: extension of the coagulation time, increasing the acidity, retaining the curd in the whey for a longer period, and not pressing the cheese. In order to control the manufacturing process, the calcium content of the cheese (which indicates the amount of strontium decontamination) can be determined. (M.M.B.)

45639 EVOLUTION OF RADIOTHERAPEUTIC TECHNIQUES. Courtial, J.; Ennuyer, A. (Fondation Curie, Paris). pp 199-226 of Radiobiologie Appliquee. Tome I. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

The evolution of radiotherapeutic techniques are outlined with a discussion of the radiation sources, the conditions for the therapeutic utilization of radiation, radiation doses, and the distribution of dose in time. (J.S.R.)

45640 BIOLOGICAL AND MEDICAL ASPECTS OF RADIOPROTECTION. Devoret, R.; Levy, C (CNRS, Gif-sur-Yvette, France). pp 775-804 of Radiobiologie Appliquee. Tome II. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

The biological and medical aspects of protection against radiation are summarized. The variables that condition the gravity of radiolesions are outlined. The lesions caused by acute and chronic irradiation are described. The long-term consequences of irradiation, i.e., cancer induction, shortening of the average life span, and genetic effects, are considered in some detail. The present level of the irradiation of the general population from natural radioactivity, medical irradiation, fallout, and eventual irradiation as a result of a nuclear industrial development is calculated. Professional exposure is discussed and examples are given. The laws governing radioprotection are outlined. The clinical and biological monitoring regulations are given. (J.S.R.)

45641 DOSE RATE–TOTAL DOSE EFFECT FROM SINGLE SHORT-DURATION GAMMA-RAY EXPOSURES ON SURVIVAL TIME IN MICE. Spalding, J. F.; Johnson, O. S.; McWilliams, P. C. (Los Alamos Scientific Lab., N. Mex.). Radiat. Res., 32: 21-6(Sept. 1967).

The effect of dose rate on mean after survival time of RF strain female mice following single exposures to ^{60}Co γ-rays was investigated. Mean after survival was not affected within the dose-rate range of 2.5 to 250/rads hour but was linearly related to total dose over the range of the twelve doses used (0 to 1200 rads). (auth)

45642 THE DETERMINATION OF RADIATION EXPOSURE FOR PATIENTS IN X-RAY DIAGNOSTICS BY SIMULTANEOUS DOSE MEASUREMENT. Gursky, S.; Barke, R. (Karl-Marx-Univ., Leipzig). Radiol. Diagn., 7: 761-9(1966). (In German).

The possibilities of patient dosimetry are demonstrated by phantom examinations and patient dosimetry. The value of diagnostic dosimeters for training and as an educational factor is undoubted. Knowing the distance of the field margin from the measuring point in the scattered radiation field one may put a relation between the surface incident dose or the surface exit dose, independent of radiation quality and field size. Simultaneous measurements of the gonad dose and other scattered doses, respectively, and of the surface incident dose and the surface exit dose, respectively, for patients in serial angiography and in routine x-ray examinations of the stomach confirm this connection. (auth)

45643 STUDIES ON THE POSSIBLE PROTECTION FROM ^{32}P INJECTED INTO PIEBALD RATS. Abdel-Wahab, M. F.; El-Mofty, Abdel Moneim; Abdin, Fatma; Nada, M. M. (Middle Eastern Regional Radioisotope Center for Arab Countries, Cairo). J. Chem. U.A.R., 9: 225-34(1966).

The protective effect of 8-methoxypsoralen (8-MOP) and ammodiaquine-HCl (AMD) against ^{32}P injected intradermally on the internal organs and skin of rats was studied. Doses of 1.5, 2, and 2.5 mCi of ^{32}P were used, which were calculated to give radiation doses of 3000 to 5000 Rep/hr. Observations were as follows: gross changes in the living animals, life-span of the animals, accumulation of the ^{32}P as shown by autoradiography, estimation of the dose rate two weeks, one month, and two months after the injection of ^{32}P, blood cell examination, bone marrow examination,

electrophoretic pattern of the blood proteins, and post mortem examination of various organs. Results showed that both 8-MOP and AMD exerted protective effects against internal irradiation from ^{32}P. Accumulation of ^{32}P was recorded in liver, spleen, kidney, lungs, genital organs, heart, brain, stomach, intestine, bones, suprarenal abdominal skin, and skin of the back in descending order; it was highest in the liver and lowest in the skin of the back. Use of 8-MOP and AMD did not alter the degree of accumulation of ^{32}P. In most rats the skin showed subcutaneous hematomas. There was focal atrophy of the epidermis, especially around the hair follicles. These changes were more marked with larger doses. (BBB)

45644 NATURAL RADIATION BURDEN IN THE PRINCIPAL CARBON DIOXIDE MOFETTAS OF ROMANIAN SOCIALIST REPUBLIC. Szabo, Endre (Tartomanyi Kozegeszsegugyi Allami Felugyeloseg, Marosvasarhely, Romania). Atomtech. Tajek., 10: 71-6(1967). (In Hungarian).

The content is given of radon and radon daughters in the atmosphere at the principal springs in the volcanic mountain range of Transylvania that are used to treat rheumatic diseases. The external radiation dose was found to be less than 2.7 rem; the internal dose due to inhalation was not determined. (W.E.B.)

45645 SANITARY LAWS OF THE COUNTRIES PARTICIPATING IN THE COUNCIL OF ECONOMIC COOPERATION IN THE FIELD OF RADIATION HYGIENE. Lyarskii, P. P.; Terman, A. V. Gig. Sanit., No. 4, 81-6(Apr. 1967). (In Russian).

A brief review is given of the history of the health laws in the field of radiation hygiene. The maximum permissible doses of external and internal radiation of the whole body and of the vital organs are tabulated. Various types of radiation are analyzed, and their effects are correlated. The maximum permissible levels of personnel clothing contamination are also tabulated for α and β emitting isotopes. (R.V.J.)

45646 SOME SECOND THOUGHTS ON TRITIUM CONTAMINATION. Coffin, Don O. (Los Alamos Scientific Lab., N. Mex.). Health Phys., 13: 1083-6(Oct. 1967).

Enclosing contaminated objects in plastic bags is a common technique for containment of air-borne radioactivity. It is shown that for objects emanating tritium gas this practice increases the radiological hazard to personnel. The bag serves as a reactor favorable to the formation of HTO vapor, which diffuses through the plastic film faster than the unoxidized gas, and is at least 1000 times more hazardous to humans. Diffusion rates and time scales for several examples are presented. The related problems of tritium gas storage and contaminated parts disposal are briefly discussed. (auth)

45647 TIME COURSE OF THE TRANSFER OF ^{90}Sr THROUGH FOOD CHAINS TO MAN. Bruce, R. S.; Bartlett, B. O.; Russell, R. Scott (Agricultural Research Council Radiobiological Lab., Wantage, Eng.). pp 33-9 of Strontium Metabolism. Lenihan, J. M. A.; Loutit, J. F.; Martin, J. H. (eds.). London, Academic Press, 1967.

From International Symposium on Some Aspects of Strontium Metabolism, Chapelcross, Scotland, May 5-7, 1966. See CONF-660561.

The contamination of diet with ^{90}Sr is affected by the rate of fallout in the previous year as well as that in the current year. This is due primarily to delays in the transfer of fallout into milk, but the delay between the production and consumption of some foods, notably cereals, must also be taken into account. When the rate of fallout is high, the ratio of ^{90}Sr to Ca in milk is similar to that in the mixed diet. Although the relative importance of milk as a source of ^{90}Sr decreases somewhat when uptake is mainly from the cumulative deposit in the soil, the integrated levels of contamination in milk and diet do not differ greatly. Therefore the ratio of ^{90}Sr to Ca in milk is a good index both of the current exposure to this nuclide when the rate of fallout is high and also of the total dose commitment. (auth) (UK)

45648 RADIATION HAZARD IN MODERN LIFE. Arnaud, Yves. Presse Therm. Clim., 103: 81-6(1966). (In French).

To clarify the hazards of artificial radiation, a discussion is given of the characteristics of natural as well as man-made radiation. Natural radioactivity is discussed in two categories, cosmic radiation and thermal radiation. The variations of cosmic radiation, depending on geographic location, and its implications on manned space exploration are mentioned. Radioisotopes in thermal baths and their possible effects are reviewed. Artificial radiation sources, both medical and industrial, are then considered. Somatic and genetic dangers of radiodiagnosis and radiotherapy are discussed. The difficulty of evaluating radiation effects from uses of nuclear energy on the majority of the population is stressed and the additional dose from such sources estimated at 0.5% beyond the effect of natural radiation. Fallout from nuclear weapon testing is discussed, and the possible resulting somatic lesions and genetic hazards are considered. Artificial radioactivity is compared with natural radiation, and it is concluded that the hazards of man-made radiation should not be exaggerated to the public. (BBB)

45649 COMPARATIVE DOSE MEASUREMENTS FOR HIGH-ENERGY ELECTRONS WITH FERROUS SULPHATE DOSIMETERS. Nagl, Johann; Santelevici, Alexandre (Internationale Atomenergie-Organisation, Vienna). Strahlentherapie, 133: 561-6(Aug. 1967). (In German).

The Fricke ferrous sulphate dosimeter is not only a reference standard for laboratory measurements, but also useful for intercomparison of dosimetry between laboratories. An intercomparison with Fricke solution in sealed glass ampoules (with thin walls) is described in this paper. Two sets of three ampoules each, imbedded in blocks of MIX-D, were distributed by air mail, together with reference ampoules, to different laboratories where the ampoules were irradiated with 5000 rd of 30 MeV electrons. One of the sets was evaluated by the respective laboratory, the second set was returned to the IAEA laboratory and evaluated there. The results show that even under unfavorable conditions an accuracy of $\pm 2\%$ can be obtained, under good conditions an accuracy of even $\pm 1\%$. The described arrangement of the dosimeters makes it also possible to check the position of the electron beam. This dosimetry intercomparison is inexpensive, only manpower and transport costs have to be taken into consideration. (auth)

45650 STUDIES ON RADIUM DOSIMETRY (CALCULATION OF DOSE DISTRIBUTION). Busch, Manfred (Univ., Freiburg i. B.). Strahlentherapie, 133: 567-84(Aug. 1967). (In German).

After reviewing the present dose calculation methods for radium, a calculation method could be developed which is mainly based on an envelope-integral and on a absorption-function of the radium-γ-radiation in platinum which has been adapted to practical conditions. The calculation is based upon the equations (28) (envelope-integral), upon the polynominal coefficients of table 4 (absorption-function), and upon the 8th procedure described in this publication (dose calculation in the lengthening of the axis by Simpson). The calculations were compared with several other dose distributions measured by Hine and Friedman, and a good agreement was found. The calculation method was mainly developed for adapting radium to a general dosage system for interstitial γ-therapy. (auth)

45651 CHEMICAL AND ELECTROLYTICAL DECONTAMINATION OF STEEL CONTAMINATED BY VARIOUS RADIOACTIVE ISOTOPES. Miazek-Kula, Maria. Pr. Cent. Inst. Ochrony Pracy, 17: 225-31(1967). (In Polish).

Decontamination of steel by a chemical and an electrolytical method were compared using steel contaminated with the isotopes ^{32}P, ^{45}Ca, ^{59}Fe, ^{65}Zn, ^{90}Sr, ^{124}Sb, ^{131}I, ^{137}Cs, ^{141}Ce, ^{198}Au, and ^{204}Tl. The results showed that, for the majority of the isotopes mentioned, a considerable part of their contamination is removed by immersion in water, in a 0.2 n H_2SO_4 solution, and in electrolytes of the following composition: 41% H_3PO_4; 11% H_2SO_4; 6% H_2O; 42% glycerine solution; 55% H_3PO_4; 20% H_2SO_4; 20% H_2O; and 5% CrO_3 solution. It was also found that a high degree of decontamination was attained by using the electrolytical anode method in a glycerine and a chromium solution during about 1 minute, with a current density of 88 mA/sq cm. (auth)

45652 TIME VARIATION OF ^{137}Cs AND POTASSIUM IN HUMANS FROM SOUTHERN SWEDEN. Bengtsson, L. G. (Lund Univ., Sweden). Acta Radiol., Ther., Phys., Biol., 6: 259-82 (Aug. 1967).

The potassium and ^{137}Cs content of 57 persons were followed from February 1964 to September 1966. Each person was measured three times annually. The potassium concentration did not increase with age for boys aged 13 to 16 years but decreased faster than expected for girls. It was possible to demonstrate age differences in the curves giving ^{137}Cs burden versus time. Curves calculated on the basis of milk data for ^{137}Cs described the time variations quite well if the biologic half-time for ^{137}Cs was assumed to be 100 ± 30 d for men, 80 ± 25 d for women, 55 ± 20 d for 14-year-old boys and 55 ± 15 d for 14-year-old girls. (auth)

45653 MEASUREMENT OF STANDARD ION DOSES IN SOLID AND LIQUID MEDIA ON X- AND GAMMA-IRRADIATION AT ENERGIES BETWEEN 50 keV AND 3 MeV. IV. INVESTIGATIONS ON THE INFLUENCE OF CHAMBER STEM OF IONIZATION CHAMBERS. Rakow, Adalbert; Will, Wolfram (Medizinisch-Biologische Forschungszentrum, Berlin. Deutsche Akademie der Wissenschafte, Berlin). Strahlentherapie, 133: 354-60(July 1967). (In German).

In order to elucidate the errors occurring during the measurement of the standard ion dose in solid and liquid media with ionization chambers, which have been calibrated in free air with a standard ionization chamber, the influence of the chamber stem in air and in a water phantom was determined. The corrections of seven commercially produced ionization chamber types can depend on the radiation quality; field size and the depth in the phantom where the measurements were taken have, however, no significant influence. Since the chamber stem causes an additional scattering for measurements in air, while the ionization measured in a water phantom is too low because of its presence, the chamber stem has an opposite influence. In the case of the chamber types investigated and the irradiation conditions used, the chamber stem can cause errors of up to 2.5% for the measurement of the standard ion dose in a solid or liquid medium if the chamber factor, which has been determined free in air, is used. (auth)

45654 USE OF LITHIUM FLUORIDE THERMOLUMINESCENCE DOSIMETRY IN RADIOBIOLOGICAL ANIMAL EXPERIMENTS. Reichel, Gerhard; Nicht, Manfred; Roesler, Bernward (Medizinische Akademie, Magdeburg, Ger.). Strahlentherapie, 133: 390-5(July 1967). (In German).

The use of lithium fluoride dosimeters in radio biological experiments with conventional X rays (200 KV, 20 mA, 0.5 mm Cu total filter, 1.10 m HVL) in rats is described. The rats were frozen and cut into cross-sections. Lithium fluoride dosimeters were implanted into various organs; the organ dose was registered simultaneously during irradiation. In the case of large rats (m = 302 g), the ratio maximum organ dose/minimum organ dose is 1.31, while in the case of small rate (m = 110 g), this ratio is only 1.16. The irradiation of large rats under the irradiation conditions used can be considered, according to the report of the ICRU, to be only a slightly homogeneous irradiation, while the irradiation of small rate can be considered as a homogeneous irradiation. (auth)

45655 RADIATION PROTECTION DURING LOCAL THERAPEUTIC HANDLING OF GAMMA SOURCES. Schwarz, Reinhold; Makedanz, Albert (Univ., Rostock, Ger.). Strahlentherapie, 133: 434-58(July 1967). (In German).

The present state of development of radiation protection for local therapeutic use of gamma-radiation sources is demonstrated by using gynecological radium therapy as an example. It is demonstrated that organisational and building measures make it possible to lower the radiation burden of medical personnel to an exposure minimum, but a further improvement can be obtained by omitting work such as packing, unpacking, and cleaning of the radiation sources, i.e., by introducing safe techniques and technology, respectively. Therefore, applicators which are corrosion resistant, hermetically sealed, and sterilizable by heat are recommended for gynecological use, and a radiation safe sterilization unit is proposed. For estimating the external radiation exposure, it is recommended to add the yearly doses of single employee groups and of all the employees of a contact therapy division; the total dose of the groups and the division is then given as a function of the yearly radioactivity in 100 mg of Ra. (81 references.) (auth)

45656 APPROXIMATION FOR THE DETERMINATION OF RADIATION RECEIVED BY FOETUSES DURING ISOTOPE PLACENTOGRAPHY. Tautz, M. (Staedtische Klinikums, Berlin). Radiol. Diagn., 7: 577-83(1966). (In German).

The method of isotope placentography with ^{131}I or ^{132}I human serum albumin used in our radiological clinic was the starting point for the report on a possible foetal radiation hazard. On the basis of a geometrical approximation of anatomical relations the gonad doses were calculated and compared with those already existing in literature. The influence of the degree of geometric approximation and the difficulties of interpretation of calculated doses are pointed out. (auth)

45657 SIMPLE SCHEMA FOR DIAGNOSTIC RADIATION DOSAGE. Pape, R. (Roentgeninstitut der Wilhelminenspitales, Vienna). Radiol. Diagn., 7: 565-70(1966). (In German).

The gonad dose can be kept within micro- to milli-R range in examinations of extremities, head, and thorax, by increasing total filtering to 3 to 6 mm Al and reducing the mA to below 1 mA during skiascopy. The values are 10 to 100 times higher in examinations of abdomen. In most examinations they remain below 1 R. The dose to gonads of children is mostly smaller than to adults, and to men (when protective measures are taken), smaller than to women. (auth)

Medicine

Refer also to abstracts 45370, 45451, 45509, 45639, and 45838.

45658 (AD-644987) VIRUS GROWTH-GENE REPRESSION HYPOTHESIS OF RADIATION PROTECTION BY AUXIN ANALOGUES. Research Paper. Norman, David; Schultz, Robert D. (Douglas Aircraft Co., Inc., Huntington Beach, Calif. Advanced Research Lab.). July 1966. Contract PH43-64-865. 23p. (DARL-14). CFSTI.

A working hypothesis was developed which postulates that death from radiation sickness in mammals is to an appreciable extent the result of the activation of initially latent but potentially cytopathic viruses, and that a radiation-protective auxin analog blocks such activation by allosterically stabilizing an active form of an auxin-sensitive repressor of a viral gene. The phenomena of lysogeny and virogeny are used as models to develop this hypothesis. (TAB)

45659 (N-67-21179) IMPROVED SULFUR HEXAFLUORIDE GAS HANDLING SYSTEM FOR A POTENTIAL DROP PARTICLE ACCELERATOR. Marsik, S. J.; Stevenson, F. R.; Deraimo, J. C. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). 1967. 7p. (NASA-TM-X-52274). CFSTI.

Purpose of the study was to determine if the prolonged restraint of laboratory animals (the rat) adversely affected absorption of fluid and electrolytes. Experiments were performed to determine the influence of chronic restraint on the transport properties of the rat small intestine for electrolyte and fluid, both in vitro in vivo; if chronic restraint caused latent effects that were manifested by more severe acute restraint; and if the effects of chronic restraint and the known changes in function that occurred after exposure to ionizing radiation were additive. Data were also obtained on the effect on calcium absorption and retention, body, kidney, femur, and femur ash weight, and the histopathology of the rat small intestine. The results did not indicate a deleterious effect either on intestinal function or on the susceptibility of the small intestine to more severe stress. Growth depression due to chronic restraint was noted, and it was found that weights of body, femur, and kidney were depressed in the same proportion. Bone mineralization was thought to be transiently affected. (STAR)

45660 (NP-16872) ETUDE DU POUVOIR RADIOPROTECTEUR DE QUATRE DERIVES DU NOYAU IMIDAZOLINE. (Study of the Radioprotective Power of Four Derivatives of the Imidazoline Nucleus). Guilhermet, Monique (Grenoble Univ. (France). Faculte des Sciences). [1964]. 50p. (In French). Dep. Thesis.

A brief history is given of radioprotection. The biological action of ionizing radiation is outlined and the nature and mechanism of radioprotective compounds are discussed. The methods, materials, and experimental techniques used in the study of the radioprotective capacity of four derivatives of the imidazoline nucleus are described. The compounds studied were as follows: 2-[(N-benzylanilino)methyl]-2-imidazoline(antazoline), 2-(4-tert-butyl-2,6-dimethylbenzyl)-2-imidazoline(otrivine), the nitrate of 2-(1-naphthylmethyl)-2-imidazoline(privine), and the chlorohydrate of m-[N-(2-imidazoline-2-ylmethyl)-p-toluidino]-phenol (regitine). The protective effects of the four compounds were tested in mice against a lethal dose of x-radiation. Regitine and privine exhibited maximum protective capacities of 20% and 98% respectively; toxicity of these two compounds was very high. It was hypothesized that the radioprotective effects observed was the result of hydroxyl function contribution by the compounds or condensation or ramification of the benzene nuclei. (E.R.B.)

45661 (ORAU-101) RESEARCH REPORT, MEDICAL DIVISION, FOR THE YEAR ENDING DECEMBER 31, 1966. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.). 199p. Dep. CFSTI.

Separate abstracts were prepared on 25 sections of the report. A list is included of 72 papers published during the period covered. (C.H.)

For abstracts of individual sections see: 45281, 45370, 45501, 45502, 45617, 45618, 45662-45672, and 45776-45783.

45662 (ORAU-101, pp 41-4) RECOVERY OF LETHALLY IRRADIATED MICE GIVEN FEWER THAN ONE MILLION SYNGENEIC BONE-MARROW CELLS. Kretchmar, Arthur L.; Conover, W. R. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

The mortality pattern of lethally x-irradiated mice given allogenic bone marrow cells was compared with that of similarly irradiated mice given syngenic cells. Results suggest that suboptimal recovery of hemopoietic and lymphoid systems occurs in lethally irradiated mice treated with inadequate doses of syngenic cells and, while the marrow treatment is sufficient to carry the animals through the period of acute radiation mortality, it is

not sufficient to permit optimal recovery of the hemic system, resulting in weight loss and delayed mortality. (C.H.)

45663 (ORAU–101, pp 78-81) HYDROUS FERRIC OXIDE COLLOID LABELED WITH ^{68}Ga. Hayes, Raymond L.; Carlton, James E.; Rafter, John J.; Byrd, Billy L. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

Hydrous ferric oxide labeled with ^{68}Ga was prepared and tested in rabbits as a possible agent for use in scintiscanning of bone marrow. Gallium-68 is readily available from a ^{68}Ga generator, and because of its 68 min. half-life the radiation dose to patients would be reasonably low even with multimillicurie amounts. The factors that influence the biologic distribution of ^{68}Ga-labeled hydrous ferric oxide preparations were investigated with emphasis on the enhancement of deposition in bone marrow. Preliminary results on the effects of particle size distribution and the effects of dextran on the distribution of the colloid in bone marrow are reported. (C.H.)

45664 (ORAU–101, pp 74-7) ^{188}Re AS A POSSIBLE DIAGNOSTIC AGENT. Hayes, Raymond L.; Rafter, John J. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

Rhenium-188 (17 hr half-life) can be obtained from a generator employing ^{188}W. Rhenium-188 has a useful photon emission and some associated high-energy radiations, but the principal photon has an energy of 155 keV. The distribution and excretion of ^{188}Re in the perrhenate form was studied in dogs and rats, and tracer studies were made in man. Rhenium-188 can also be incorporated into a sulfur colloid, and its distribution in animals resembles that of ^{99}Tc sulfur sol. The advantages of ^{188}Re as a tracer for scintiscanning in diagnosis are discussed. (C.H.)

45665 (ORAU-101, pp 81-2) STUDIES WITH ^{113m}In. Hayes, Raymond L.; Byrd, Billy L. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

The use of ^{113}In as a tracer for scintiscanning of the bone marrow and brain was investigated. Indium-113 is available from a ^{113}Sn generator. Results are reported from preliminary studies on the distribution of ^{113}In in the citrate form, in hydrous ferric oxide colloid, and in the EDTA form in the tissues of rats. (C.H.)

45666 (ORAU–101, pp 83-6) TECHNIQUES TO PROVIDE STERILE AND PYROGEN-FREE RADIOPHARMACEUTICALS FROM LONG-LIVED GENERATORS. Edwards, C. Lowell; Hayes, Raymond L. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

Techniques are described to ensure sterile and pyrogen-free radioisotope solutions from nuclear generators for use in the preparation of labeled pharmaceuticals. It is pointed out that a large number of elutions of radioisotopes over extended periods increases the chance for contamination. A program of testing of elution for bacterial contamination and 0.22 μ filtration to ensure the sterility of the final preparation is described. (C.H.)

45667 (ORAU–101, pp 89-90) TOTAL-BODY IRRADIATION. Comas, Frank V.; Edwards, C. Lowell; Andrews, Gould A.; Vodopick, Helen; Kniseley, Ralph M. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

Data are summarized on the use of whole-body γ radiation in the treatment of leukemia and various neoplasms. (C.H.)

45668 (ORAU–101, pp 90-1) SPLEEN AND LIVER IRRADIATION IN CHRONIC GRANULOCYTIC LEUKEMIA. Comas, Frank V.; Edwards, C. Lowell; Vodopick, Helen; Andrews, Gould A. (Oak Ridge Associated Universities, Inc., Tenn. Medial Div.).

Irradiation of the spleen in patients with chronic granulocytic leukemia resulted in a reduction of the peripheral white cell count, changes in the myelocyte-erythroid ratio in bone marrow, and reduction of spleen volume. The γ radiation dose was divided into 10 equal fractions given during a three-week period and adjusted so that the product of the midplane dose (in rads) by the volume irradiated (in cm^3) equaled 4×10^6. The response after spleen irradiation was significant; irradiation of the liver resulted in a variable response. (C.H.)

45669 (ORAU–101, pp 96-9) BONE-MARROW SCANNING WITH RADIOACTIVE COLLOIDS. Kniseley, Ralph M.; Edwards, C. Lowell; Andrews, Gould A.; Tanida, Ryosaku; Hayes, Raymond L. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

Two radiopharmaceutical approaches to bone marrow scanning include the use of Fe radioisotopes or colloids labeled with various radioisotopes as tracers. The use of Fe isotopes is based on the fact that most of an intravenously injected tracer dose of Fe is transported to the bone marrow and incorporated into erythrocytes during hematopoiesis. The use of colloids is based on the fact that colloids are removed from the body by reticuloendothelial cells of the liver, spleen, and bone marrow. Evidence from animal and clinical studies indicates that the distribution of radio-colloids in the bone marrow closely correlates with the distribution of radio-iron. Iron-59 is readily available, but owing to its long half-life and radioactivity it may be given in doses of only 0.05 μCi or less, and this makes it unsatisfactory for scanning. Iron-52 can be given in doses sufficient for scanning, but owing to its short half-life and difficulties in its production, it is limited to only a few institutions. Results of bone marrow scans using ^{99}Tc-sulfur colloid, ^{198}Au-colloid, and ^{68}Ga-ferric oxide colloid are compared with those obtained using ^{52}Fe. The colloids all gave usable scans, but scans made using ^{68}Ga-ferric oxide as a tracer gave the best resolution and ^{68}Ga-ferric oxide had a better blood clearance time than did the other colloids used. (C.H.)

45670 (ORAU–101, pp 100-2) SKELETAL SCANNING WITH ^{68}Ga CITRATE. Edwards, C. Lowell; Ahumada, J.; Hayes, Raymond L. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

Bone scans of the entire skeleton, or of areas of specific interest, were made on 75 patients using ^{68}Ga administered with 2 to 4 mg of stable Ga citrate/k/body weight. The scans were interpreted as normal in 52 patients. Of 23 patients with abnormal scans, the skeletal lesion was a malignant neoplasm in 14 cases. The remaining were caused by a variety of lesions. In two patients suspected of having bone metastases, the ^{68}Ga scans succeeded in locating the lesions where x-ray examinations had failed. The possible toxic reactions to Ga observed in six patients are described. It is concluded that ^{68}Ga can be a useful agent for the detection of metastatic bone lesions. (C.H.)

45671 (ORAU–101, pp 106-11) THEORETICAL AND EXPERIMENTAL STUDIES ON RETENTION AND DISTRIBUTION OF RADIONUCLIDES. II. ANALOG COMPUTER ANALYSIS OF HUMAN ^{51}Cr RBC SURVIVAL AND WHOLE-BODY RETENTION DATA. Lushbaugh, C. C.; Gibbs, William D.; Franz, W.; Bergner, Per-Erik E. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

A biological model is presented for the survival of injected ^{51}Cr-labeled erythrocytes in normal or diseased man. The chromium-damaged cells are assumed to have two simultaneous independent removal mechanisms: senescence, as for any undamaged erythrocyte, and a removal mechanism that destroys erythrocytes independently of age. Both destructive processes occur in two functionally different parts of the reticuloendothelial system, with about 40% of the random destruction occurring in the spleen. Computer analysis of data on parameters measured by the model gives more meaningful information than that furnished by measurements of the T50 of the labeled erythrocytes. (C.H.)

45672 (ORAU–101, pp 166-8) CORRECTION OF WHOLE-BODY COUNTING RETENTION STUDIES WITH RADIOISOTOPE TRACERS. Gibbs, William D.; Hodges, H. D.; Lushbaugh, C. C. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

A method is described for testing the efficiency of whole-body counting techniques for man after the ingestion or intravenous injection of tracer doses of radioisotopes. A small intravenous calibration dose of the tracer is counted in the subject before an oral dose is given. The method was tested with the use of point sources of ^{59}Fe in a man-sized compartmental water phantom using a multicrystal whole-body scintillation counter. Multichannel energy spectra counts were made with a point source of ^{59}Fe located at 30 different positions in the phantom. (C.H.)

45673 THE USE OF ^{32}P IN THE COMPLEX THERAPY OF EPILEPSY. Rasin, S. D.; Tsvetkova, V. V.; Sinitskii, V. N.; Sisetskaya, T. P. Med. Radiol., 12: No. 7, 37–41(July 1967). (In Russian).

Phosphorus-32 in combination with other substances was used for the treatment of 26 patients with severe epilepsy. Radiophosphorus was administered via the mouth in a glucose solution in a dose of 25 mC twice a week (a total of 250 mC). A good therapeutic effect was achieved in 20 cases, in 10 of them there was a complete disappearance of paroxysms and their equivalent, whereas in other 10 patients they occurred rarely. In 5 cases the number of paroxysms did not change, but they became shorter; only in one patient the seizures became more frequent, necessitating the discontinuance of the treatment. Follow-up studies (8 to 14 months later) showed that in 6 cases the effect of treatment proved to be stable. In patients who violated the regimen there occurred paroxysms, but not so often as before the treatment. The authors recommend radiophosphorus as an additional means in the complex treatment of epilepsy. (auth)

45674 CLINICAL POSSIBILITIES OF DIFFERENTIATION OF RADIATION HEMATOLOGIC REACTIONS. Chone, B. (Univ., Heidelberg). Radiobiol. Radiother., 8: 335-50(1967). (In German).

The reliable differentiation and classification of radiation-induced morphologic changes of blood within the clinical area of tolerance by means of counting and staining is problematic. This especially applies in the case of chronic-subliminal radiation exposure. In this case compensatory counter-regulations occur along with the direct cellular effects of injury, and simultaneously a certain accustoming effect has to be considered. Hematologic changes after a single whole-body or fractionated local radiation exposure in the therapeutically effective dose range are simpler to evaluate. An increase in diagnostic significance may be achieved by using autoradiographic and cytochemical procedures. Electron microscopy will increase diagnostic significance also. Electronic registration of fluctuations in leucocytic volume, the determination of which is based on the inductive effect of giant cells is at present the most sensitive method for an exact detection of an effective radiation injury in the peripheral blood. It permits a true morphologic early diagnosis unequaled by any of the usual conventional methods of counting. (auth)

45675 EXAMINATIONS ON THE LONG-RANGE ACTION OF RADIOGENIC PRODUCTS. PART I. INFLUENCING OF ^{32}P UPTAKE BY JENSEN SARCOMA IN VITRO BY SERUM BY WHOLE-BODY-IRRADIATED RATS. Rose, H. (Humboldt-Univ., Berlin). Radiobiol. Radiother., 8: 325-30(1967). (In German).

Starting from the problem of the long-range action of ionizing radiation, the results of the action of serum of whole-body irradiated rats on the ^{32}P uptake of Jensen-sarcoma in vitro is reported. A retarding as well as stimulating reaction was found that depended on the radiation dose and the time after irradiation in which the serum was obtained. (auth)

45676 RADIATION THERAPY OF ACTINOMYCOSIS. Muehlich, H.-E.; Strietzel, M. (Medizinische Akademie Carl Gustav Carus, Dresden). Radiobiol. Radiother., 8: 313-20(1967). (In German).

Radiotherapy was given to 72 patients with actinomycosis. Histological verification was made for 75%, while 25% gave clinically reliable pictures. For one to seventeen years following irradiation, 62.4% of the patients were observed. Only one patient died of actinomycosis. In view of this, a combination of antibiotics with radiotherapy was regarded as the method of choice. A dose of 1000 to 2000 R SD was recommended. (E.R.B.)

45677 SHORT-DISTANCE IRRADIATION OF INFANTILE HEMANGIOMAS WITH SMALL DOSES. Neumann, J.-G. (Bezirkskrankenhauses, Cottbus, Ger.). Radiobiol. Radiother., 8: 281-91(1967). (In German).

The experiences in applying small x-ray doses for the treatment of infantile hemangiomas with short distance irradiation are reported. Maximally 3×100 R/s were given fortnightly. Of these 487 hemangiomas irradiated in this manner and observed for 10 years, a good cosmetic result was achieved in 82.1%. The dose used was 15 to 50% of the maximum dose previously used. A clinically demonstrable damage could not be found in any case. The method was used to an increasing extent during the period of this report. The results were at least equally good if not better than soft radiation therapy. The exposure of gonads during soft-radiation therapy was 10 to 30 kV; with this method, 2×150 R/s maximally in intervals of three months was expected to be insignificant. (auth)

45678 THE INFLUENCE OF VITAMIN B_8 AND PANTOTHENIC ACID ON RADIATION SYNDROME OF WHOLE-BODY IRRADIATED RATS. Schmidt, W.; Morczek, A. (Medizinische Akademie, Magdeburg, Ger.). Radiobiol. Radiother., 8: 361-7 (1967). (In German).

The effect of panthenol and vitamin B_8 on radiation syndrome was tested on 192 white rats that were whole-body irradiated with 600, 800, 1000, and 1200 R/s in groups of 24 animals each. Biostatistical evaluation of the results showed a significant increase of survival rate following the administration of panthenol after irradiation at 600 r. In sublethal doses (600 r and 800 r) panthenol and vitamin B_8 had a statistically significant stimulating effect on regeneration of reticulocytes, erythrocytes and thrombocytes. After irradiation at lethal doses, a decreased depression of blood-elements could be demonstrated during the first week. There was, however, no effect favoring reparation by vitamin B_8 and panthenol of the radiation syndrome. (auth)

45679 CHEMICAL PROTECTION OF THE NUCLEI OF LEUCOCYTES OF HUMAN PERIPHERAL BLOOD AGAINST X RAYS. Dzhemilev, Z. A.; Perepelkina, L. D.; Machavariani, M. G. (Inst. of Experimental Pathology and Therapy, Sukhumi, USSR). Genetika, No. 9, 91-5(1967). (In Russian).

The protective action of thiourea was investigated by the cultivation of leukocytes from the human peripheral blood. The cultures were irradiated with x-rays at a 100 R dose at various stages of the cell cycle. The effect of protection was different at different stages of the cell cycle. The maximal protecting effect was observed at the G_1 stage of the cell cycle. It was established that the protector exerted its influence on the initial processes of chromosome damage (restoration of potential damages) and had no influence on the secondary processes (confluence and non-influence) of the acentric fragments that were formed in consequence of chromosome breaks. (auth)

45680 RADIATION-INDUCED REMISSIONS IN CHRONIC LYMPHOCYTIC LEUKEMIA. Johnson, Ralph E.; Kagan, A. Robert; Gralnick, Harvey R.; Fass, Leroy (National Cancer Inst., Bethesda, Md.). Cancer, 20: 1382-7(Sept. 1967).

Excellent remissions have been attained in symptomatic but previously untreated patients with chronic lymphocytic leukemia. The primary therapy has consisted of total-body irradiation using intensive fractionated dosage schedules. In four of six consecutive patients, the differential blood counts on both the peripheral blood and bone marrow smears returned to normal following treatment. Supportive blood transfusions were not required for bone marrow depression and a nonhemolytic anemia in three patients was corrected by irradiation. Symptomatic improvement consistently occurred and the in vitro transformation of cultured lymphocytes stimulated with phytohemagglutinin returned to normal limits in several patients studied. Review of the medical literature clearly documents the rarity of such remissions in chronic lymphocytic leukemia. These results indicate the treatment described is one of the most effective therapies yet reported for induction of remission of this disease. (auth)

45681 ADDITION OF LOCAL RADIATION AFTER BONE MARROW REMISSION IN ACUTE LEUKEMIA IN CHILDREN. Sharp, Harvey L.; Nesbit, Mark E.; D'Angio, Giulio J.; Krivit, William (Univ. of Minnesota, Minneapolis). Cancer, 20: 1403-4(Sept. 1967).

Ten children with acute leukemia were treated with local γ radiation therapy following bone marrow remission. Although local infiltrates in the liver and kidneys seemed to have been eliminated, the ultimate outcome in regard to relapse and survival remained unchanged. (auth)

45682 THE REMOTE RESULTS OF TREATMENT WITH ^{204}Tl RADIATION OF INFLAMMATORY DISEASES OF THE ANTERIOR REGION OF THE EYE. Denisyuk, S. D. Med. Radiol., 12: No. 7, 41-5(July 1967). (In Russian).

Low doses of ^{204}Tl β radiation were found to be an effective means for the treatment of inflammatory diseases of the anterior region of the eye (episcleritis, keratitis of diverse etiology) and for the prevention of relapses after operative removal of the pterygium. In numerous examinations of patients subjected to thalium-204 irradiation the author found no complications in the healthy tissues of the eye 3 to 4 years after treatment. (auth)

45683 CLINICO-MORPHOLOGICAL CHANGES IN MALIGNANT THYROID TUMORS AFTER PREOPERATIVE DISTANCE GAMMA-THERAPY. Kiseleva, E. S.; Maslov, N. P.; Gel'bshtein, M. I. (Gertsena Scientific-Research Inst. of Oncology, Moscow). Med. Radiol., 12: No. 7, 24-30(July 1967). (In Russian).

Fifty-two patients with malignant tumors of the thyroid gland underwent combined treatment consisting of preoperative distance gamma therapy and subsequent operation. Focal doses ranged from 2,000 to 5,000 rad. In doses of 2,000 to 3,000 rad clinical and morphological signs of radiation injury of the tumor and metastases were observed only in morphological forms of mildly differentiated forms and in children and adolescents. Focal doses of 3,1000 to 5,000 rad in all patients caused a distinct reduction of the tumor, but in a diffuse process enabled radical surgery to be performed. The most marked radiation injury was observed in anaplastic, solid, and solid-follicular thyroid tumors. In children and adolescents even highly-differentiated papillary and papillary-follicular tumors were sufficiently radiosensitive. The optimal terms for the operation were 3 to 4 weeks after therapy. Preoperative irradiation did not complicate the operation and postoperative course, created conditions for an ablastic operation, helped to increase the indications for radical surgery, especially in non-differentiated tumors of the thyroid gland. (auth)

45684 INVESTIGATION OF THE DOSE FIELD UNDER A SCREEN IN DISTANCE GAMMA THERAPY. Sarkisyan, Yu. Kh. (Research Inst. of Roentgen-Radiology, Moscow). Med. Radiol., 12: No. 7, 14-17(July 1967). (In Russian).

Distance gamma therapy is conducive to sparing of the underlying tissues, thus enabling irradiation of larger areas of tissues with diverse radiosensitivity. The dose characteristics of linear gamma therapy through a lead screen were studied in dose fields in a

tissue-like phantom. The screen represented a lead plate 4.5 cm thick with holes. Dosimetric studies by the photomethod and with the aid of radiophotofluorescent glass detectors were used to determine the character of dose field distribution in open and closed areas of the lead screen on the surface of object irradiation and at different depths. The use of a lead screen leads to a very irregular irradiation within the limits of one irradiation field. The dose under closed areas (surface and at a depth of up to 5 cm) comprises only 25% to the dose over open areas. Clinical observations on patients with malignant tumors of the urinary bladder subjected to distance gamma therapy through a lead screen are also presented. (auth)

45685 NUCLEAR MEDICINE: A NEW DISCIPLINE. Vetter, Herbert (IAEA, Vienna). Isotop. Radiat. Technol., 4: 183-6(Winter 1966-1967).

Nuclear medicine is defined as a special field in which radioisotopes are used for diagnosis. The present status and probable future of this discipline are discussed. (auth)

45686 ESSENTIAL DIFFERENCES AND TREATMENT OF HEMORRHAGIC SYNDROME IN ACUTE RADIATION SICKNESS PROVOKING THE INFECTION AND CAUSING ITS INTOXICATION. Kiselev, P. N.; Nikitina, K. I. Med. Radiol., 12: No. 5, 73-5(May 1967). (In Russian).

A direct correlation was established between the number of microbes introduced into the organism, the level of bacteremia, and the gravity of hemorrhagy in radiation sickness. During the development of the hemorrhagic syndrome, the organism becomes autoinfected by the endotoxin of the bacteria. In order to clarify this phenomenon, the effect of immunization with the endotoxin of E. coli; antitoxic sera, and other nonspecific detoxicating media on the initiation and duration of the hemorrhagic syndrome and the outcome of radiation sickness was investigated. Guinea pigs were immunized with the endotoxin E. coli at a rate of 50 to 70 μg/kg, repeating the treatment six times at three day intervals, after which the animals were exposed to 200 R of x radiation. The vaccination reduced the mortality rate by a factor of three and attenuated the embrittlement of the capillaries while improving the coagulation of the blood. In order to determine the contribution of the antibodies to the immunization effect, the antibody content of the blood of the immunized animals was compared with the hemorrhagic index and the number of leukocytes in the peripheral blood, determining the agglutinin content. It was found that the radiation killed only animals with low antibody content. The hemorrhagic syndrome and leukopenia indexes in the blood of the surviving animals were only slightly affected. This indicated that the resulting anti-endotoxin detoxicated the irradiated organism. (TTT)

45687 EFFECT OF LACTIC CASEIN ON THE COURSE OF RADIATION SICKNESS IN WHITE RATS. Boyadzhiev, S.; Peychev, P.; Marovski, T. (Pavlov Higher Medical Inst., Plovdiv, Bulgaria). Rentgenol. Radiol., 5: 237-41(1966). (In Bulgarian).

Both experimental and control rats were irradiated with x-rays at lethal doses of 900 to 1000 R. In addition to the regular diet that the control animals received (milk, bread, oats, and water), the irradiated animals were fed casein daily for two weeks before and one month after irradiation. The length of survival of the casein-fed animals after irradiation was increased as compared with that of control animals. The casein-fed animals showed a less pronounced leukopenia and had higher erythrocyte count and hemoglobin content on the 18th and 25th days after irradiation. (JPRS)

45688 SOME OF THE MEDICAL PROBLEMS FOLLOWING A NUCLEAR ATTACK. Baltrukiewicz, Zenon. Lek. Wojsk., No. 11, 973-81(1966). (In Polish).

Selected medical problems of a thermonuclear war, in particular, the immediate results of a nuclear attack are discussed. It is pointed out that in spite of general opinion the main causes of injury during the initial period after the attack and within a large radius of the zero point are not due to nuclear radiation but rather due to the effect of fire and shock waves. Losses resulting from the blast will be mainly due to the excess pressures, and will manifest themselves as bursting tympanic membranes and lungs. Tumbling buildings and objects flying tens of kilometers away will be the next cause of injuries. Thermal radiation, mainly infrared radiation, will result in body burns and ignition of inflammable materials in the range of many kilometers. The duties of the health service during that period will consist in the selection of the injured who should and still can be helped. These will include patients with: surface burns, damaged retina and pulmonary system, torn soft tissues and broken bones, and radiation sickness. During the subsequent period, the efficient combat of sanitary-epidemic problems will be of great importance. Due to the fact that in the case of a thermonuclear attack there will be no clear division between the front line and rear or safety region, the evacuation concept will be useless and all available help should be directed to the activity on the spot. Psychological effects of the attack as well as their treatment are discussed briefly. (JPRS)

45689 STUDY ON ANTITHYROID DRUGS PLUS ROENTGEN IRRADIATION IN THE TREATMENT OF HYPERTHYROIDISM. Takagi, Kazuko (Tottori Univ., Yonago, Japan). Yonago Igaku Zasshi, 16: 566-79(Dec. 1965). (In Japanese).

The effect of combined antithyroid drug administration and x irradiation on hyperthyroidism was studied experimentally and clinically. From the results, it appears that the radiosensitivity in the group treated by x irradiation after injection of mercazole was higher than in the group treated by mercazole injection after x irradiation. Of 19 patients with hyperthyroidism, treated by x irradiation to the thyroid region (700 to 3500 R with 1350 R average dose) after one week administration of mercazole with a daily dose of 30 mg, 17 patients were cured. The mean period of mercazole administration was 2.8 months. (NSA of Japan) (TSS)

45690 STUDIES ON THE THYROID FUNCTION TEST BY MEANS OF WHOLE BODY LINEAR SCANNING. Oshiumi, Yoshihiko (Hiroshima Red Cross Hospital, Hiroshima Atomic Bomb Hospital); Kiyonari, Hideyasu. Nippon Igaku Hoshasen Gakkai Zasshi, 26: 1462-70(Feb. 1967). (In Japanese).

A combined study of whole body linear scanning and ^{131}I-uptake 1, 3, 6 and 24 hours after oral administration of $Na^{131}I$ was made. How ^{131}I distribution in the body changed with time and thyroid function was studied. The curve of whole body scanning had two remarkable peaks. One showed the amount of ^{131}I taken up in the area corresponding to thyroid gland. The other was between xyphoid process and umbilicus, which means ^{131}I distributed in many organs such as stomach, liver, spleen, pancreas and small intestine. But it is considered that stomach played the most important role to account for the latter peak. The height and area of these peaks change with time and the changes were influenced by the condition of thyroid function. The relation between the area of these peaks and thyroid function was investigated. Consequently we confirmed that the peak recognized between xyphoid process and umbilicus showed exactly the condition of thyroid function in 6 hours after administration. (auth)

45691 RESULTS OF RADIATION TREATMENT OF MALIGNANT TUMORS IN OUR CLINIC. Hara, Masaaki; Ogushi, Ikuyo (Tottori Univ., Yonago, Japan). Yonago Igaku Zasshi, 16: 524-31 (Dec. 1965). (In Japanese).

Results are reported on radiotherapy of malignant tumors using x radiation (200 keV, 25 mA) fixed, sieve, and pendulum irradiations and intubation and needling of Ra and ^{60}Co. Of 315 cases of uterine cancer, 5 year survival percentage of 80 cases treated by post-operative irradiation and of 44 cases treated by radiotherapy alone were 80% and 43.1%, respectively. Of 133 cases of breast cancer, most post-operatively irradiated, 54 cases, or 63%, showed 5 year survival. Of 82 cases of maxillary cancer, 18.7% showed 5 year survival. About two thirds died within one year. Of 67 cases of malignant struma, 53.6% showed 5 year survival. The histological examination disclosed that adenocarcinoma was the largest in number (65.7%) and 70.6% showed 5 year survival. Of 51 cases of lung cancer, 26 could be followed. Of these, 22 cases died within one year, 3 died after over a year, and only 1 had no recurrence until 7 years and 2 months after therapy. Of 36 cases of tongue cancer, 27.3% showed 5 year survival. There were 35 cases of esophageal cancer; and their mean survival was 7 months. Of 27 cases of laryngeal cancer, 57.1% showed 5 year survival. Of 61 cases of malignant lymphoma, 34.1% showed 5 year survival. Fifty of these 61 cases were reticulosarcoma. (NSA of Japan) (TSS)

45692 CONFORMATION RADIOTHERAPY BY LINEAR ACCELERATOR X-RAYS. Kitabatake, Takashi (Aichi Cancer Center Hospital, Japan); Takahashi, Shinji. Nippon Igaku Hoshasen Gakkai Zasshi, 26: 1448-54(Feb. 1967). (In Japanese).

A conformation-radiotherapeutic servomechanism was attached to a linear accelerator. A collimator was divided into six fractioned diaphragms on both sides. Each of 12 fractioned diaphragms had a different servomechanism, which act following signals from the signal generator during rotation of the gantry. Mechanical error of this mechanism measured in 12 channels of the servo system ranged from +1.47% to −1.80%, which may be of little significance for clinical use. Dose distribution of using this machine in the treatment of cancer of the uterine cervix, is shown in figures. A dense area (region to be treated) appears to be sharper and better coincident with a geometric beam focus

(planned treating region) than that obtained by a telecobalt-therapy apparatus. Some excellent characteristics of x rays from a linear accelerator, such as high depth dose-rate, sharp x ray beam, and less reduced skin dose, may contribute to easy and rational application for conformation radiotherapy. (NSA of Japan)

45693 BIOLOGICAL PROTECTION MECHANISM OF RADIOPROTECTORS IN MAMMALIAN CELLS. VIII. MITOTIC BEHAVIOR IN THE CELL CYCLE OF NORMAL EHRLICH ASCITES TUMOR CELLS AND THOSE TREATED WITH MEA USING THE 8-AZAGUANINE METHOD. Kobayashi, Jindo; Kawamura, Fumio (Tokushima Univ., Japan). Tokushima J. Exp. Med., 13: No. 1-2, 35-42(Aug. 1966).

The effect of MEA (2-mercaptoethylamine) in shortening the cell cycle of Ehrlich ascites tumor cells was studied. Ehrlich ascites tumor cells were collected from animals (Swiss albino strain mice) inoculated with tumor 7 days previously. The tumor cells were injected intraperitoneally into groups of five mice. Radioprotector (MEA) and 8-azaguanine treatments were done on the fifth and sixth days after transplantation. It was found that MEA had the most effect on mitosis when given 1 hour before or after 8-azaguanine treatment. The effect of MEA in shortening the cell cycle was measured as the period from the middle of the descending part of a mitotic curve to the middle of the ascending part. All the periods of the cell cycle were shortened considerably by administration of MEA. (NSA of Japan)

45694 BIOLOGICAL PROTECTION MECHANISMS OF RADIOPROTECTORS IN MAMMALIAN CELLS. IX. MITOTIC BEHAVIOR IN THE CELL CYCLE OF NORMAL EHRLICH ASCITES TUMOR CELLS AND THOSE TREATED WITH AET USING THE 8-AZAGUANINE METHOD. Kobayashi, Jindo; Kawamura, Fumio (Tokushima Univ., Japan). Tokushima J. Exp. Med., 13: No. 1-2, 43-51(Aug. 1966).

The mechanism of the radioprotective effect of AET (2-aminoethyl-thiuronium bromide HBr) was investigated by studying its effect on the cell cycle of Ehrlich ascites tumor cells. The tumor used was the Ehrlich tumor, an ascites tumor of mice. For the tumor transfer Swiss albino mice weighing 20 to 25 g were used. With 8-azaguanine as a mitotic inhibitor, AET caused a shortening of the generation time in the cell cycle. One radioprotective mechanism of the radioprotector based on the cell metabolism may be a shortening of the cell cycle. (NSA of Japan)

45695 COLOR SCINTIGRAM FOR DETECTION OF BRAIN TUMORS. Noguchi, Shikazo (Kurume Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 1418-38(Feb. 1967). (In Japanese).

The author performed brain scanning in 122 patients in the period from April 1961 to October 1965 with results as follows: (1) When ^{131}I labeled human serum albumin (RIHSA) was used, Lugol's solution was given a few days prior to the injection to protect the thyroid. After the blocking, RIHSA was given intravenously and a dose was adjusted between 300 to 460 mCi according to the body weight. Scanning was performed 24 to 48 hr after the injection as a routine, and if necessary, repeated scans were made within 120 hr. With RIHSA, more accurate diagnosis may be expected with interval scans because the isotope tends to localize in the tumor with time. (2) When ^{203}Hg or ^{197}Hg tagged Neohydrin was used, non-radioactive Neohydrin was given one day earlier by intramuscular route to reduce irradiation of the kidneys. Scanning was started about one hour after the injection but the scan could not be repeated because of short physical half-life in the body. The author's experience is limited and a dose similar to RIHSA was used. (3) Usually, the scan was made on the anterior projection, and then on the lateral. If an abnormal pattern was found on the anterior projection, the posture of the patient was changed so that the side with the abnormality was closed to the detector. Furthermore, if an abnormality existed in the occipital areas, the scan was made on the postero-anterior projection for accurate diagnosis. Care was taken to hold the posture and fix the head. (4) When both RIHSA and ^{203}Hg–Neohydrin were given in the same dosage, RIHSA was more concentrated in the tumor than Neohydrin. It would appear that the histologic types of tumor which concentrate RIHSA will also concentrate Neohydrin; conversely, the tumor types which concentrate one of these substances poorly, also concentrate the others poorly. So, the author mainly used RIHSA, and ^{203}Hg–Neohydrin as a supplement. (5) Brain scannings were made in 122 cases, of which 66 had brain tumor and their diagnoses were established mostly by operation or biopsy. Thirteen cases had a non-neoplastic disease (proved surgically in all) and in 2 others no histological diagnosis was established and they were placed under observation. The remaining 41 cases has no intracranial disease by subsequent tests, and displayed no positive scan. (6) Brain tumors which were detected with high accuracy were meningioma, some glioma, craniopharyngioma and metastatic tumors. The location of intracranial tumor was an important factor in the detection by scanning. The diagnostic accuracy was higher in the cerebrum and cerebellum, but was hard in the brain basis or brain stem. (7) In the group of 13 patients who had non-neoplastic intracranial disease, the scans were negative in epilepsy and brain lues, but often positive scans were obtained in cerebral vascular accident, haematoma, abscess, or softening encephalitis, and these could hardly be differentiated from neoplastic tumor. (8) Forty-one patients who had no intracranial disease displayed a negative pattern; this group had been suspected to have brain tumor but proved to be negative by the scan. As mentioned above, brain scanning is a powerful tool in brain tumor detection. This method is very simple and involves absolutely no risks to the patient. (auth)

45696 PVP-^{131}I TREATMENT BY FRACTIONAL INJECTION FOR HYPERTHYROIDISM. Kanai, Takehiko (Juntendo Univ., Japan). Nippon Naika Gakka Zasshi, 54: 1355-66(Mar. 1966). (In Japanese).

PVP(polyvinylpyrroiidone) increases the accumulation of ^{131}I in the thyroid gland and also prolongs its effective half-life. Utilizing this effect of PVP for the clinical purpose, PVP-^{131}I was administered to 161 cases of hyperthyroidism and the subjective symptoms and data of clinical examinations before and after PVP-^{131}I administration were examined. To obtain its mild effect, a small fractional dose, 1 mCi per injection (a month) of PVP-^{131}I, was intramuscularly given. When the monthly clinical examination showed no improvement, and additional 1 mCi (of PVP-^{131}I) was administered. The results obtained are as follows: (1) The subjective symptoms were remarkably improved, the body weight was increased by more than 5 kg in 32.3% of the whole cases, and the cases with tachycardia were reduced from 34.0 to 9.3%. (2) The cases with high BMR were reduced from 87.2 to 22.9% and in 84.5% ^{131}I-uptake was restored to normal. (3) The patients with high PBI were reduced from 16 to 2, the patients with low serum total cholesterol from 76 to 49, and the patients with high alkaline phosphatase from 37.8 to 18.9%. (4) The cases showing an abnormal EKG were reduced from 41 to 10%. (5) Of the 161 cases, 132 (81.9%) were cured, 22 (13.6%) were improved, and 7 (4.3%) remainedthe same. (6) The total amount of PVP-^{131}I administered was in the range of 5 to 15 mCi, and was 5.8 mCi on the average. (NSA of Japan)

45697 A STUDY ON RADIOLYMPHOGRAPHY. Saito, Yasuichi (Tottori Univ., Yonago, Japan). Yongao Igaku Zasshi, 16: 596-610(Dec. 1965). (In Japanese).

The usefulness of functional and formal examinations, using a radioisotope on the lymphatic system, was investigated by making local measurements and linear etc., scannings. The results obtained are as follows: (1) For the linear and phase scannings with a radioisotope, ^{198}Au was found to be superior to $^{131}IHSA$ and ^{177}Lu. (2) The remaining ratio tended to increase when lymph-node trouble was at the iliac etc. positions, depending on the individual subject. (3) In the linear scanning, clear distribution curves were obtained 4 hours after administration. Lymph-node trouble appeared as a decrease in the activity of lymph nodes. (4) After 24 hours, the scintigram image gave clear images of lymph nodes. The distribution was clear in the iliac etc. positions, but the form of each lymph node could not be known due to the insufficient resolution of images. (5) Because the scintigram gave information on the position and distribution of lymph nodes, it was applicable for determining the irradiation procedure for deep lesions. (NSA of Japan)

45698 RADIOIODINE ABSORPTION TEST IN TUMORS. Shima, Takayoshi; Saito, Yasuichi (Tottori Univ., Yonago, Japan). Yongao Igaku Zasshi, 16: 611-15(Dec. 1965). (In Japanese).

Small amounts of $Nd^{131}I$ were injected into tumors and local scannings were made; the half-lives (T) of the ^{131}I absorption rate were then obtained. The various influencing factors were investigated. The results obtained are as follows: (1) In the animal experiments, using spontaneous breast-cancer tumors transplanted subcutaneously to C_3H mice, the T value of a ^{131}I tumor absorption curve was not much dependent on the size of the tumor, but was closely related with the distribution of blood vessels in the tumor; the value was less in the higher degree of distribution. (2) After the absorption test of subcutaneous tumors, they were x irradiated with 600 R and the absorption test was repeated three hours after. The value of T was markedly reduced, in comparison with the non-irradiated ones. (3) ^{131}I absorption tests were made on 30 patients with benign or malignant tumors. The T value was found to be increased in the central soft part of tumors, etc., compared with the corresponding subcutaneous part. (4) In the lymph-node, metastatic-lesion at the neck of a

squamous cell carcinoma, the value of T was apparently reduced by 1200 R x-irradiation, from that of the control. From the above results, it is indicated that the ^{131}I absorption test of a tumor is related to the tumor and the subcutaneous blood-stream rate around it. The tendency concerning the radiosensitivity of tumors may be predicted by means of the tests. (NSA of Japan)

45699 EFFECT OF THE X-IRRADIATED TUMOR BED ON TUMOR CELLS. PART II. EFFECT OF TUMOR BED ON CELLULAR RADIATION SENSITIVITY. Urano, Muneyasu (Kyoto Prefectural Univ. of Medicine). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 1372-83(Jan. 1967).

The effect of x-irradiated tumor beds on cellular radiation sensitivity was investigated. Tumor bed effect (TBE) was clearly demonstrated, when the 50 percent local tumor control dose (TCD-50) in 100 days of a 0.7 ml. Takizawa-sarcoma was calculated by logic analysis. The TCD-50 in 100 days of tumors in normal tumor beds was 5526 rad, while that of tumors in tumor beds irradiated before transplantation was 7367 rad. The ratio of TCD-50 in irradiated beds to that in normal beds was 1.33. When it was presumed that 10 to 100 cells are enough to cause irradiated tumors to recur, survival curves of Takizawa-sarcoma cells in a 0.7 ml. tumor could be drawn between a straight line with as extrapolation number (N) of 1 and a 37 percent dose (D_{37}) of 308 rad and a curve with N = 3 and D_{37} = 331 rad. On the other hand, survival curves of tumor cells in irradiated tumor beds could be drawn between a line with N = 1 and D_{37} = 411 rad, and a curve with N = 3 and D_{37} = 440 rad. The ratio of D_{37} of the tumor in irradiated tumor beds to that of tumor in non-irradiated tumor beds was 1.33. Tumor bed changes due to irradiation, especially changes of vascularisation, are considered to be a main factor of acquired radioresistance of tumors recurring in previously irradiated regions. (auth)

45700 EFFECT OF ROSMARICINE ON MICE WITH ACUTE RADIATION SICKNESS. Grishaenkov, V. M.; Ivanov, M. I.; Legchaev, V. Ya. Med. Radiol., 12: No. 5, 69-70(May 1967). (In Russian).

The effect of rosmaricine, a new alkaloid prepared from Rosmarinus afficinalis, was examined in mice exposed to 900 R of x radiation. The experimental variables included administration of 100 mg/kg of the 1% solution of rosmaricine hydrochloride twice before, twice after, and once before – once after irradiation. The effects of these prophylactic, therapeutic, and combined prophylactic-therapeutic treatments were evaluated from the survival rates of the animals. No protective effect was detected in either case. The alkaloid reduced the average life of the animals in the control group. (TTT)

45701 PERSONAL EXPERIENCE IN THE RADIOTHERAPY OF ANO-RECTAL NEOPLASIAS. Ferolla, G.; Berganzi, L.; Borghi, P. I. (Univ., Modena, Italy). Minerva Radiol., Fisioterap. Radiobiol., 12: 172-9(1967).

Case material consisting of 78 patients with ano-rectal neoplasias is reported. The advantages and disadvantages of surgery and radiotherapy are discussed and the various local and transcutaneous techniques for applying radiotherapy are illustrated. Sixty-two of the patients were suffering from recto-sigmoid carcinomas and 16 from anal carcinomas. The therapeutic approach followed was generally surgical associated with transcutaneous radiotherapy in operable cases and local interstitial and contact radium therapy associated or otherwise with roentgen therapy and telecobalt therapy in inoperable cases. Mention is also made of five patients who were subjected to preoperative radiotherapy with telecobalt therapy followed by recto-sigmoid resection. The theoretical advantages of this technique are discussed. The long term results for recto-sigmoid neoplasias are generally a three year survival of 23 to 24% and five year survival of 22%. For anal forms five year survival was 31%. The most effective treatments proved to be the association of surgery and transcutaneous radiotherapy, and local radium therapy plus irradiation from the outside. (auth)

45702 EFFECT OF ORAL NEOMYCIN THERAPY FOLLOWING WHOLE-BODY X-IRRADIATION OF RATS. Webster, J. B. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Radiat. Res., 32: 117-24(Sept. 1967).

The beneficial effects of oral antibiotic treatment with neomycin following whole-body x-irradiation of Sprague–Dawley rats was examined. Survival times of irradiated, neomycin-treated male rats were compared with those of irradiated, untreated controls. Eleven selected radiation exposures, beginning at 700 R and extending in increments to 2500 R, were used. Thirty-day lethality was also evaluated at and below exposures of 1100 R. Neomycin treatment resulted in a significant prolongation of the mean survival times of irradiated animals at exposures between 800 R and 1500 R. At exposures between 1500 R and 2500 R, a small but consistent prolongation of mean survival time resulted. For exposures between 700 R and 1100 R, the 30-day lethality was consistently lower for the neomycin-treated rats. Postirradiation treatment with oral neomycin, administered every 12 hours, seemed to effect an increase in the mean survival time of whole-body x-irradiated rats. (auth)

45703 POTENTIATION OF LASER ONCOLYSIS WITH PRETREATMENT X-IRRADIATION. Hoye, Robert C.; Gart, John J.; Weiss, George H.; Riggle, Grant C.; Ketcham, Alfred S. (National Cancer Inst., Bethesda, Md.). Radiat. Res., 32: 112-16 (Sept. 1967).

A combination of x-rays and neodymium laser energy was used to irradiate the S-91 melanoma in CDF_1 mice. The number of tumors destroyed without further recurrence was compared to those obtained by either mode alone. The combination therapy was shown to be significantly more effective than either x-rays or laser radiation, at the same level of toxic effects. (auth)

45704 STABILITY OF THE IODINE-LABELED TOLUIDINE-CONTAINING POLYVINYLPYRROLIDINE (PVP-T ^{131}I) ACCORDING TO GORDON AND OF ^{3}H-POLYVINYLPYRROLIDINE (^{3}H-PVP). Loebe, J.; Lieschke, H.-J.; Hartmann, H.; Koch, H.; Seige, K. Radiol. Diagn., 7: 771-6(1966). (In German).

The instability of Gordon's test-substance (iodine-labelled, toluidine-containing polyvinylpyrrolidine) for the detection of exudative enteropathy is demonstrated. This preparation is thermolabile and within days at room temperature it splits off larger amounts of ionogenic ^{131}I. Within hours it comes to a nearly complete deiodisation in organism. Therefore, it is not suited for model albuminous body. The PVP was labeled with tritium and obtained a thermostable product. For this reason this tritium PVP (^{3}H-PVP) seems to be suited better for a model-substance. (auth)

45705 RADIOISOTOPE RENOGRAPHY IN THE EVALUATION OF HIGH-ENERGY BEAM RADIOTHERAPY OF CANCER OF THE URINARY BLADDER USING WEDGE FILTERS. Pozza, F.; Marigo, A.; Valdagni, C.; Pistolesi, G. F. (Univ., Padua). Acta Isotop., 6: 109-28(1966). (In Italian).

Radioisotopic renograms were performed at various time intervals before and after irradiation in 21 patients with carcinoma of the bladder at stages T_2–T_3. The radiotherapy was carried out using electromagnetic radiations of 17.5 MeV (betatron) with wedge filters of 45°. The results of the renographic examinations support the reliability of the radiotherapy technique employed, in relation to the local radiocurability of the tumor as well as to the limitation of radiation damage. (auth)

45706 THE PRESENT SITUATION OF MEDICAL USES OF RADIOACTIVE ISOTOPES IN HUNGARY. Vandor, Ferenc. Atomtech. Tajek., 10: 59-63(1967). (In Hungarian).

The following topics are discussed: number of laboratories using radioisotopes for diagnosis and therapy; progress in diagnosis of thyroid, kidneys, lungs, and blood-forming organs; treatment of liver and spleen; cobalt-60 applicators used in gynecology; teletherapy using cobalt-60 in a stationary-field 1200 Ci unit and in a moving-field 3000 Ci unit; and biological and medical research. (W.E.B.)

45707 THE WHOLE BODY COUNTER AT KYOTO UNIVERSITY. ITS STRUCTURE AND SOME CHARACTERISTICS. Fukuda, Masasi; Torizuka, Kanji; Hamamoto, Ken; Fujii, Masahiro; Mori, Toru; Furumatsu, Tisako (Kyoto Univ. Medical School). Radioisotopes (Tokyo), 16: 209-14(May 1967).

A description is given of the structure and some characteristics of the whole body counter at Kyoto University. The counter is intended for use in radiation protection and medical diagnostic investigations. Three types of detectors are set for whole body counting of human subjects: one 8 in. × 4 in. NaI(Tl) crystal scintillation probe; four sets of probes consisting of a 1.5 in. × 1.5 in. NaI(Tl) crystal and a photomultiplier tube, and four plastic scintillation probes. Output signals from the detectors are analyzed in a 400-channel pulse-height analyzer and a dual-channel pulse-height analyzer. Some data of this counter are presented. (auth)

45708 DATA ACQUISITION FOR COMPUTER ANALYSIS AND DISPLAY OF RADIONUCLDE SCANS. Chaapel, D. W. (International Business Machines Corp., Rochester, Minn.); Sprau, A. G.; Tauxe, W. Newlon Int. J. Appl. Radiat. Isotop., 18: 723-7(Oct. 1967).

The most popular approaches to improving radioactive-scanning procedures (television enhancement, color-coded "photographs," and scanner replay via magnetic tape), are described, to show their deficiencies in providing the clinician with the means of signifi-

cantly advancing his diagnostic techniques. A description is presented of one approach to the application of digital computers to the field of radioisotope scanning. Consideration is given to the nature of the scanner as a data source, the equally important auxiliary information (such as patient identification), a data collection technique (magnetic tape) and the basic flow of the computer analysis and display functions. In addition, typical computation times are presented for a few representative systems (IBM 7090, 7040, and 1460 Data Processing Systems). (auth)

45709 A NEW COLLOIDAL ^{68}Ga-COMPOUND FOR LIVER SCANNING. Anghileri, L. J.; Prpic, B. (Inst. fuer Nuklearmedizin, Heidelberg). Int. J. Appl. Radiat. Isotop., 18: 734-5 (Oct. 1967).

Gallium-68 appears to be a promising radioisotope for organ scanning. Its advantages are a short half-life of 68 min, which decreases the dose delivered to the organ, availability from a long half-lived ^{68}Ga generator (250 days), which makes this radioisotope accessible to institutions remote from reactors and it is a β^+ emitter (with a 511-keV positron annihilation gamma-emission) which allows coincidence scanning to be performed. Until now it has been used in several different forms: as a citrate for bone scanning, as an EDTA-chelate in brain-scanning and kidney function studies, and as ^{68}Ga-labeled hydrous ferric oxide colloid in scanning of the reticulo-endothelial system. ^{68}Ga-hydroxide complexes have also been used for lung, liver and kidney scanning. In the work described a liver scanning agent has been developed which is prepared by coprecipitation of ^{68}Ga with a colloidal chromic phosphate. Its application to rats is described. (auth)

45710 A SIMPLIFIED METHOD FOR BONE MINERAL MEASUREMENTS IN VIVO. Spring, E. (Univ. Central Hospital, Helsinki). Int. J. Appl. Radiat. Isotop., 18: 709-11 (Oct. 1967).

A method for measurement of the bone mineral content in vivo was developed by J. R. Cameron and J. A. Sorenson [Science, 142: 230(1963)]. The object of measurement, for example the radius in the forearm, is placed in a water container of even thickness. The transmission rate of low energy gamma-radiation is measured at even-spaced intervals across the bone. This method requires automatic data collection and computer calculations. A simplified method is described in this paper. The transmission rate is measured continuously across the bone, and observed with a ratemeter; the results are registered with a strip-chart recorder. The scale of the chart is based upon the natural logarithm of the ratio of the transmission rate in water to the rate when the radiation in addition crosses the bone. The content of bone mineral can be calculated within a few minutes by taking from the curve values which correspond to 1 mm intervals across the bone. The results are reproducible to within 4%. (auth)

45711 CLINICAL CONTRIBUTION ON THE USE OF TELECOBALT THERAPY IN OESOPHAGEAL CARCINOMA. Cugini, A.; Sosso, A. (Univ., Turin). Minerva Radiol., Fisioterap. Radiobiol., 12: 158-72(1967).

Forty-two patients with oesophageal carcinoma were treated with telecobalt therapy. Technical problems form the subject of another note and are not considered here. The present paper concerns elements of a clinical nature and the study of survival in relation to those factors which may condition its duration. Emphasis is laid on the usefulness of telecobalt therapy which, while not contributing significantly to improving survival averages is almost always a useful therapeutic tool and is able temporarily to improve disturbances in oesophageal canalization. (auth)

45712 THE EFFECT OF ^{60}Co IRRADIATION ON RETICULOSARCOMA WITH SUPERIOR VENA CAVAL SYNDROME. Masue, Katsuhiko (Tottori Univ., Yonago, Japan). Yonago Igaku Zasshi, 16: 532-6(Dec. 1965). (In Japanese).

Three cases of reticulosarcoma are reported in which a superior vena caval syndrome was caused with an enlarged shadow of the mediastinal structures on the chest film, and the symptoms were rapidly improved with a shrinkage of the mediastinal shadow by telecobalt irradiation. The three cases were 24, 28, and 36 year-old men who all died in spite of the application of radiotherapy and administration of carcinostatic agents. However, subjective symptoms of the syndrome completely disappeared following short-period, massive telecobalt irradiations, namely, total doses of 1000 to 2000 R given in 3 to 7 fractions. In the treatment of tumors such as reticulosarcoma that spread all over the body, the existing irradiation-method is not feasible, because it takes 3 weeks to complete the irradiation of a field, and the general conditions are subsequently aggravated. Therefore, it seems that the short period, massive irradiation, which shrinks the tumor rapidly and makes possible earlier irradiations of other tumors, is essential. (NSA of Japan)

45713 COMBINED IRRADIATION, INTRA-ARTERIAL CHEMOTHERAPY, AND SURGERY FOR THE TREATMENT OF SARCOMAS OF THE EXTREMITIES. Yonemoto, Robert H.; Byron, Ralph L. Jr.; Jacobs, Melville L. (City of Hope Medical Center, Duarte, Calif.). Surgery, 61: 355-60(Mar. 1967).

Effectiveness of ^{60}Co therapy in a combined program for treating sarcomas is described. Treatment consisted of: intensive preoperative irradiation (5000 rad) to the lesion over 5 days immediately preceding operation; intra-arterial administration of 20 mg nitrogen mustard with simultaneous venous occlusion during the first phase of surgery; and amputation or disarticulation of the extremity. Since the 5000-rad dose of γ irradiation was given over a 5-day period rather than the usual 5 to 6 weeks, it was imperative to follow with amputation because of the intense reaction and injury of tissue this irradiation induces. The level of the amputation was high enough to secure a nonirradiated healthy flap for closure. An additional margin of 1 to 2 in. of skin and soft tissue was included with the amputated part because of the radiation scatter. Four of the 16 patients with osteosarcomas treated with the combined approach are living and well 23 to 72 months postoperatively, or an average of 48 months. In the group not irradiated, only one of 6 patients is alive at 86 months. Some patients were given prebiopsy irradiation in the range of 500 to 1000 rad to damage cells which might have escaped during the course of the biopsy. The time interval between preoperative irradiation and surgery is critical. Experiments have shown that with a split-dose technique mammalian cultured cells recover rapidly from the radiation damage. If this principle applies to human malignant cells, surgery should be performed as soon as possible following irradiation to obtain the greatest effect. Other experiments in animals have indicated that a sublethal dose of preoperative irradiation of 500 to 1000 rad significantly improves survival. (BBB)

45714 CHROMOSOME MARKER STUDIES IN THE IRRADIATED CHICK EMBRYO. Moore, M. A. S.; Owen, J. J. T. (Oxford Univ.). Nature (London), 215: 1081-2(Sept. 2, 1967).

Repopulation of irradiated adult animals by injected myeloid cells has received much attention, and the studies have provided a considerable amount of data on haemopoietic stem cells. The work reported in this communication was designed to investigate the capacity of cells of various embryonic organs to populate the haemopoietic tissues of the irradiated embryo, the chick embryo being especially suited to such a study, since haemopoietic cells can be injected intravenously into it, and also because the sex chromosome difference between male (ZZ) and female (ZW) cells provides a marker method for distinguishing the contributions of host and donor to haemopoietic recovery. A total of 800 rads from a ^{60}Co source, at a dose rate of 66 rads/min., was administered to embryos incubated for 13 days. Some of the irradiated embryos were injected with cell suspensions prepared from either 7 day yolk sac, 14 day spleen, 16 or 18 day bone marrow, or 14 or 18 day thymus. A total of 10×10^6 cells of male sex was injected intravenously in each case. In an additional experiment, 0.1 ml quantities of whole blood removed from 13 day male embryos were injected into irradiated hosts. Results of chromosome analyses are presented in tabular form. Over the very short time period studied there was partial recolonization of haemopoietic tissues by yolk sac, spleen, bone marrow or blood cells. No comparable repopulation was found after injections of thymocytes. Some tentative conclusions are drawn concerning the potentialities of embryonic stem cells for haemopoietic development, in particular that the population of haemopoietic organs of the irradiated embryo by injected myeloid cells supports the role of blood-borne cells in embryo haemopoiesis and suggests that the embryo stem cell has a wide range of developmental capacities. (UK)

45715 ^{99m}Tc(V): CITRATE COMPLEX FOR ESTIMATION OF GLOMERULAR FILTRATION RATE. Kountz, S. L.; Yeh, S. H.; Wood, J.; Cohn, R.; Kriss, J. P. (Stanford Univ., Palo Alto, Calif.). Nature (London), 215: 1397-9(Sept. 23, 1967).

Compounds and techniques used for estimating the rate of glomerular filtration are reviewed, and it is stated that a compound labeled with a gamma emitting isotope and excreted entirely by glomerular filtration would make the study of renal function much easier. The technetium-99m (V)-citrate complex is a new and easily synthesized compound, and distribution and scintiphotographic studies indicated that it is rapidly excreted by the kidney as the intact complex. Technetium-99m also has the favorable physical characteristics of short half-life (6h) and low gamma energy (140 keV). A study is described of the mechanism of its renal excretion in dogs, using both the single injection and standard clearance techniques, and comparison made with ^{131}I-diatrizoate. The compound did not bind to red blood cells, and there were no acute toxic reactions. Clearances, distribution volumes, and intercompartmental clerances were computer calculated. Results agreed very largely with those for ^{131}I-diatrizoate.

It would be especially valuable to have techniques which would eliminate the need for urine collections; the ^{99m}Tc complex might prove useful in this connection. Results suggest that the Tc complex, like ^{131}I-diatrizoate, fulfills the requirement for a compound for estimating glomerular filtration rate, and should be valuable in the investigation of renal functions. (UK)

45716 POSITION INDICATIONS AND DOSIMETRY OF ENDOLYMPHATIC THERAPY WITH ^{131}I-LIPIODOL. **zum Winkel, Karl; Becker, Josef; Jahns, Eberhard; Scheurlen, Hans; Herzfeld, Ulrich (Univ., Heidelberg). Strahlentherapie, 133: 481-98(Aug. 1967). (In German).**

Experiences with 45 patients (47 administrations) with endolymphatic administration of ^{131}I-Lipiodol are reported. The selection of patients was based upon the results obtained with lymph node scintigraphy. The activity administered was 2 × 10 mCi of ^{131}I-Lipiodol. Detailed studies of distribution in the metabolism and deposition of the radioactive Lipiodol were done using whole body counters, scintigraphy, and lymphadenography. A different effective half life time was observed in the lymphatic system, the lungs, and the thyroid gland. The uptake of Lipiodol into these organs was also different. Frequently a high radiation dose was obtained in the lymphatic system, but involved lymph nodes were often spared by the Lipiodol uptake or showed only an insufficient dyeing with the contrast medium. In those cases, as well as in cases of insufficient regression of enlarged lymphomas, percutaneous radiation therapy has to follow. Endolymphatic therapy with radioactive Lipiodol is an additional technique with radiotherapeutic posibilities, but it is not able to replace proven radiotherapeutic procedures. (auth)

45717 FREQUENCY, PATHOGENESIS, AND CLINICAL SYMPTOMS OF ARM EDEMA FROM MAMMARY CARCINOMA. **Gregl, Anton; Poppe, Hanno; Poehls, Hartwig; Kienle, Juergen; Schwartz, Thomas; Stelzner, Joerg (Univ., Goettingen, Ger.). Strahlentherapie, 133: 499-515(Aug. 1967). (In German).**

1155 women with breast cancer were treated with a combined therapy (surgery and irradiation) in the Departments of Surgery and Radiology of the University Hospital in Göttingen. Edema of the arm was observed in 387 cases (35.5%). A classification of the edema into 3 groups was done in 347 women (light, moderate, and severe edema). A moderate edema was observed in 47.5% (165/347), a light edema in 27.7% (96/347), and a severe edema in 24.8% (86/347). The appearance of severe edema (circumference of 6 cm or more) was found more often with an advanced stage of the disease, as well as after very extended surgery, and with the occurrence of post-operative complications. The investigations have shown that preventive measures in regard to the treatment of arm edema should be based primarily upon a prevention of complications immediately after surgery. (auth)

45718 STUDIES ON SUBCUTANEOUS FIBROSIS FOLLOWING COBALT THERAPY AND TREATMENT WITH DIMETHYLSULFOXIDE. **Frommhold, Walter; Bublitz, Gunter (Strahlenabteilung des Staedt. Auguste-Viktoria-Krankenhauses, Berlin). Strahlentherapie, 133: 529-38(Aug. 1967). (In German).**

Little attention has been paid to induration of the subcutaneous tissue occurring after high doses of telecobalt therapy of gynecological tumors. It can cause considerable trouble, especially in corpulent women. To find an effective treatment, the influence of Dimethylsulfoxide (DMSO) upon the induration was studied. Histological, electron-microscopic, and chemical investigations were done in excised skin from the fibrotic areas before and after local application of DMSO. Mainly biochemical changes with minimal morphological changes were found in the pathologically increased collagene; and they are discussed in detail. All patients who were treated with DMSO show a distinct improvement of the radiation induced induration. (auth)

45719 CHANGES IN PERIPHERAL BLOOD PICTURE DURING AND AFTER A SYSTEMATIC RADIATION OF LYMPHOGRANULOMATOSIS. **Boutis, Lazaros; Hoffmann, Peter; Musshoff, Karl (Medizinische Univ., Freiburg i. B.). Strahlentherapie, 133: 539-48(Aug. 1967). (In German).**

Changes occurring in the peripheral blood picture during and after irradiation were investigated in 39 patients with lymphogranulomatosis, who received a systematic therapeutic and prophylactic irradiation. The number of all cellular elements of the blood (except of the erythrocytes) decreases during therapy, in some cases down to the tolerance limit, but within 1 to 2 months after irradiation the values return to normal. The same hemodynamic events were observed even in those cases which received consecutive focal destruction doses of all lymph node regions of the body including neck and groin within a few months. Initial chemotherapy does not considerably increase the damage. The changes in the blood picture caused by Prednisone are not very significant. Early systematic Megavolt therapy of patients with lymphogranulomatosis promises an optimum tolerance of the bone marrow. (auth)

45720 STUDIES ON A TEST FOR ADRENAL CORTEX FUNCTIONING FOR USE IN RADIOTHERAPY. **Riessbeck, Karl-Heinz (Humboldt Univ., Berlin). Strahlentherapie, 133: 549-60(Aug. 1967). (In German).**

During radiation therapy of different types of carcinomas it was observed that the determination of dehydroepiandrosterone in the urine by means of column chromatography or polarographic analysis can reveal reactions of the hypophysis-adrenal cortex system better than other currently popular hormone analyses. For additional information about the functional ability and the still present reserves of the adrenal cortex, an ACTH-test was done prior, during or after radiation therapy, and the dehydroepiandrosterone was determined in a 24 hour urine prior and after intramuscular injection. With the determination of this hormone alone by polarography, a better functional measurement of the adrenal cortex and its reserves can be done than with the determination of groups of different hormones or their metabolites. This hormone is probably in the beginning of a series of metabolic events of the adrenal cortex reserve with the ACTH in the radiation therapy of carcinomas is discussed by means of examples. (auth)

45721 TECHNIQUE AND DOSE DISTRIBUTION FOR TREATMENT OF CANCER OF THE LARYNX WITH A CESIUM UNIT. **Nordberg, Ulla-Brita; Olivecrona, Hans (Lund Univ., Sweden). Acta Radiol., Ther., Phys., Biol., 6: 105-12(Apr. 1967).**

A technique for the treatment of cancer of the larynx confined to the vocal cords, using a cesium unit, is described. The standard collimator of the apparatus was furnished with a special collimator and wedges. The dose distribution was determined in a tissue-equivalent phantom. Cooling of the irradiation area of the skin in connection with the treatment seems to reduce the skin reaction. (auth)

45722 CATABOLISM OF ALBUMIN AND GAMMA GLOBULIN AFTER TREATMENT WITH IONISING RADIATION TO THE ABDOMEN. **Birke, G.; Jacobsson, F.; Liljedahl, S. O.; Plantin, L.-O.; Wetterfors, J. (Karolinska Sjukhuset, Stockholm. King Gustaf V Research Inst., Stockholm). Acta Radiol., Ther., Phys., Biol., 6: 113-21(Apr. 1967).**

Investigations by means of isotope-labeled proteins on the enteric loss of albumin and gamma globulin caused by ionizing radiation to the abdomen in eight cases of carcinoma of the bladder and three cases of hypernephroma are described. It was found that losses of protein occur even when the radiation is well circumscribed but that no detrimental effects on the albumin or gamma globulin concentrations occurred when precautionary measures were taken. (auth)

45723 PREPARATION OF A COLLOIDAL SOLUTION OF ZIRCONYL PHOSPHATE WITH ^{32}P FOR RADIOTHERAPEUTIC PURPOSES. II. CHEMICAL STABILITY AND ACUTE TOXICITY STUDIES. **Hussein, A. M.; Kassem, A. A.; El-Garhy, M.; Madkour, M. K.; Abdullah, E. (Atomic Energy Establishment, Cairo). Atompraxis, 13: 262-5(June 1967).**

Studies on the preparation of zirconyl phosphate (^{32}P) colloid showed that the time for coagulation of the colloid depends on the temperature at which the colloid is produced. The stability of the colloid was investigated. The ionic ^{32}P content of the colloid determined by radiochromatography and dialysis proved not to be more than 2.12%. The toxicity was tested by means of i. v. injections, using mice. Per 100 g body weight the LD_{50} was found with reference to 926.2 μg Ar, the fiducial limit being (95%) of 768.3–1117 μg Zr per 100 g body weight. (auth)

45724 INFLUENCE OF THIAMINE TETRAHYDROFURFURYL DISULFIDE ON THE RADIATION SYNDROME. **Graul, E. H.; Ruether, W.; Kovacs, G. (Philipps Univ., Marburg, Ger.). Atompraxis, 13: 269-70(June 1967). (In German).**

A new vitamin B_1 derivative, TTFD, was examined for its possible radioprotective or therapeutic effects. In comparison with vitamin B_1, this substance has a remarkable pharmacological activity. After daily administration (10 d, p. r.) the dose reduction factor for TTFD was 1.34 and 1.12 for THD. The radiation-induced loss of body and small-intestine weight of mice and rats was prevented, partly or completely, by TTFD. Histological examination of the small intestine revealed that TTFD activates cell kinetics. (auth)

45725 THE ISODOSES OF WEDGE FIELDS. A NEW REFERENCE AND CALIBRATION SYSTEM. **Debois, J. M. (Akademisch Ziekenhuis, Leuven, Belg.). Acta Radiol., Ther., Phys., Biol., 6: 283-8(Aug. 1967).**

The different reference systems used for wedge fields are compared and a simple reference system is proposed. Although

this system does not conform to the ICRU recommendations, it has some advantages, mainly for a rapid survey of the possibilities of a variable step wedge filter. The fact that the axis depth doses of all systems run parallel leads to the important conclusion that the axis depth dose of a plain field can be applied to wedge fields. Therefore, a uniform system in agreement with the ICRU recommendations can be established. (auth)

45726 MEASUREMENT OF DOSES FROM HIGH-ENERGY ELECTRON BEAMS AT SMALL PHANTOM DEPTHS. **Svensson, H.; Hettinger, G. (Univ. of Umea, Sweden). Acta Radiol., Ther., Phys., Biol., 6: 289-93(Aug. 1967).**

Ferrous sulphate dosimeters were used for the measurement of doses at small phantom depths, the layer of the liquid being between 0.7 mm and 0.9 mm. The influence of irradiation cells and measurement time on the response are discussed. (auth)

45727 EFFECT OF COMPLAMIN ON RADIATION-INDUCED ERYTHEMA. **Notter, G.; Tsioulias, T.; Asard, P.-E. (Karolinska Sjukhuset, Stockholm). Acta Radiol., Ther., Phys., Biol., 6: 294-8(Aug. 1967).**

The effect of Complamin given in an oral dose of 2.7 g per diem on the development of radiation erythema was examined in 11 patients and compared with 10 controls. No radiation-protective effect of Complamin on the skin was apparent. (auth)

45728 FRACTIONATION IN RADIOTHERAPY OF CANCER OF THE LIP. **Mitchell, J. S.; Mitchell, L. Mary (Cambridge Univ., Eng. Addenbrooke's Hospital, Cambridge, Eng.). Acta Radiol., Ther., Phys., Biol., 6: 299-312(Aug. 1967).**

A detailed account is given of a retrospective study of the influence of fractionation on the results obtained with a particular technique of roentgen therapy. This work is based on the treatment in years 1946–1959 inclusive of 215 cases of histologically verified primary squamous carcinoma of the lower lip in men. There is evidence of large and statistically significant differences between the results obtained by different schemes of fractionation, with the same total minimum tumor dose and the same overall time of treatment. (auth)

45729 SPLIT-COURSE RADIOTHERAPY OF CANCER. **Holsti, Lars R. (Univ. Central Hospital, Helsinki). Acta Radiol., Ther., Phys., Biol., 6: 313-22(Aug. 1967).**

The results of split-course radiotherapy in 204 cases of cancer of the lung, esophagus, oral cavity and urinary bladder were compared with those in 146 continuously treated cases. The results were no worse when conventional continuous therapy was abandoned and replaced by split course therapy with a rest interval halfway through the treatment. (auth)

45730 CASTRATION IN MAMMARY CANCER: SURGERY OR RADIATION. **Lalanne, C. M.; Juret, P.; Hourtoule, F.; Sarrazin, D. (Institut Gustave Roussy, Villejuif, France). Acta Radiol., Ther., Phys., Biol., 6: 323-34(Aug. 1967). (In French).**

Surgery and radiotherapy were compared with a view to determining which gave the more effective result and which was the more convenient in producing castration in cases of cancer of the breast. Tests of the amount of gonadotropin contained in the urine two and six months following castration revealed a slight advantage in favour of radiotherapy. The respective advantages of the two methods have also been compared clinically with reference to the hazards involved. Neither method exhibited any outstanding advantage apart from the ease with which irradiation could be applied. (auth)

45731 EFFECT OF IRRADIATION AND OR 2-β-AMINOETHYLISOTHIOUREA ON THE APPEARANCE OF GIANT NUCLEI IN THE CRYPTS OF THE SMALL INTESTINE OF THE MOUSE. **Maisin, J. R.; Lambiet, M.; Mattelin, G. (Centre d'Etudes de l'Energie Nucleaire, Mol, Belg.). Compt. Rend. Soc. Biol., 160: 2495-8(1966). (In French).**

The effects of x rays and 2-β-aminoethylisothiourea (AET) on the surface modifications of the nuclei of the progenitor cells of the small intestine crypts are reported. Male mice were exposed to an x ray dose of 1350 R, and labeled thymidine was injected intraperitoneally. The majority of the giant nuclei present in the mucosal cells of the small intestine were synthesizing DNA at the moment of irradiation. A large number of giant nuclei were incapable of incorporating thymidine in the DNA 24 hrs and more after irradiation. The majority of the giant nuclei that could incorporate thymidine in their DNA did so more intensely after irradiation than normally. Fewer giant nuclei were labeled (when the thymidine was injected immediately after irradiation) in the mice protected before irradiation than in mice irradiated without protection. (tr-auth)

45732 RECOVERY EFFECT OF HETEROLOGOUS LIVER, KIDNEY, THYMUS, AND SPLEEN-DNA INJECTED INTO TOTAL-BODY IRRADIATED (600 R) ADULT MALE MICE AND INFANTILE MALE RATS. **Savkovic, Nada; Kacaki, J. (Inst. of Nuclear Sciences Boris Kidrich, Belgrade). Strahlentherapie, 133: 406-10(July 1967).**

Results are reported from studies that show that effects of lethal x irradiation of both adult male mice and infantile male rats can be modified by heterologous deoxyribonucleic acid after irradiation. (auth)

45733 THE ENDOCAVITY GYNECOLOGICAL CURIE THERAPY BY ^{137}Cs (APPARATUS WITH NONRADIOACTIVE PREPARATION). **Delouche, Gilles; Milhaud, Francine; Gest, Jean. J. Radiol., Electrol. Med. Nucl., 48: 229-42(May 1967). (In French).**

A γ radioapplicator is described that uses ^{137}Cs for gynecological applications. The principal advantage of ^{137}Cs is that it assures a better protection of the personnel without decreasing the quality of radiation received by the patient. The ^{137}Cs source can be stored permanently in a mobile cart whose relatively small weight permits its movement from one room to the next. Moreover the sources are placed in holders in different combinations which permit them to be adapted to each particular case. This method avoids all intermediary manipulation. Another important advantage of the method concerns the dosimetry, which is much more precise that with the use of Ra. (tr-auth)

45734 THE PURIFICATION RATE ^{133}Xe, INDEX OF THE CIRCULATORY ACTIVITY OF TUMOROUS TISSUE. **Bru, A.; Combes, P. F.; Vergnes, R.; Regis, H.; Naja, A. J. Radiol., Electrol. Med. Nucl., 48: 281-6(May 1967). (In French).**

The rate of purification of ^{133}Xe offers a diagnostic tool for studies on thyroid nodules already explored by scintigraphy. The principle of the method and the techniques used are given. The results show that in the use of this method for diagnosis of tumors in general, it could be compared with other modes of exploration of intratumoral circulation. (tr-auth)

45735 TWO CASES OF LEUKEMIA 5 TO 6 YEARS AFTER X-RAY THERAPY OF CHROMOPHOBIC ADENOMA OF THE HYPOPHYSIS. **Maslova, N. P.; Popov, S. E. Probl. Gematol. Pereliv. Krovi, 12: No. 8, 54-6(Aug. 1967). (In Russian).**

Two cases of leukemia developing 5 to 6 years after x ray therapy in doses of 6000 to 7000 R of chromophobic adenoma of the hypophysis are described. It is supposed that development of leukemia in both cases was associated with preceding x ray therapy. However, no diseases of the blood were observed in other 100 patients with the same diseases and treated with gamma- or x rays, the course dose being less than 5000 R. (auth)

45736 SYMPOSIUM ON THE TRAINING OF SPECIALISTS FOR RADIOLOGY. **Schumann, E. Radiol. Diagn., 7: 509-37 (1966). (In German).**

Radiology as a unitary and independent branch of medicine with regards to its content and methods is discussed. It was emphasized that the training of specialists should be aimed at qualification for all phases of radiology with possible stress on radiodiagnosis, radiotherapy, or nuclear medicine. Thus, the requirements of health services as well as the ability of individual radiologists to specialize in a particular branch would be taken into consideration. Future training programs are outlined and discussed. (B.H.S.)

45737 ADVANTAGES AND DISADVANTAGES OF ISOTOPE PLACENTOGRAPHY WITH ^{99m}Tc COMPARED WITH HUMAN SERUM ALBUMIN LABELLED WITH ^{131}I AND ^{132}I. **Deckart, H.; Herzmann, H.; Pockrandt, H.; Reichel, W. S. (Staedtische Klinikums, Berlin). Radiol. Diagn. 7: 571-6(1966). (In German).**

Comparative placentographic investigations with three radiopharmaceuticals are reported. All three preparations had the same investigation technique and diagnostic accuracy (over 90%). The fetal radiation dose was in mR range, its relation ^{132}I : ^{99m}Tc : ^{131}I was 1 : 10 : 100. Human serum albumin (HSA) labeled with ^{131}I was inexpensive and could be used immediately; the other two preparations were costlier and their labeling had to be done in a clinical laboratory. A practical labeling apparatus, developed by the authors and available commercially, is described. Whereas HSA labeled with ^{131}I was rejected because of too high irradiation of the fetus, ^{99m}Tc-HSA could not, in spite of certain advantages, be recommended for placentography because of its proven in vitro and in vivo instability. Iodine-132-labeled-HSA appeared to be the optimal preparation. (auth)

45738 SCINTIGRAPHY WITH ^{125}I. **Georgi, M. (Univ., Heidelberg). Radiol. Diagn., 7: 585-92(1966). (In German).**

Iodine-125 has some substantial advantages in comparison to ^{131}I that is often used for scintigraphy. They were the reduction of radiation dose received by the organ being investigated, higher

sensitivity of sodium iodide crystals to the characteristic soft radiation of ^{125}I, and the lowering of natural background radiation by using very thin crystals. The low energy of radiation allowed the construction of very thin-walled collimators that enabled very good resolution. The value of ^{125}I in localization diagnosis of the thyroid gland and in liver scintigraphy was demonstrated. (auth)

45739 LIVER SCINTIGRAPHY WITH SODIUM MOLYBDATE LABELED WITH ^{99}Mo AND ^{131}I ROSE BENGAL. Hennig, K.; Strietzel, M.; Woller, P. (Radiologische Klinik, Dresden). Radiol. Diagn., 7: 619-25(1966). (In German).

Molybdate accumulated in the liver and enabled a good scintigraphic visualization of the organ through its disintegration into easily measurable ^{99m}Tc. In contrast to ^{131}I-rose bengal, which has a relatively rapid passage and is excreted by the biliary system, ^{99}Mo-sodium molybdate remained relatively long in the liver cell. The results of liver scintigraphy with molybdate and on comparative investigations with ^{131}I-rose bengal are reported. (auth)

45740 RADIOLOGICAL DIAGNOSIS AND DIFFERENTIAL RECOGNITION OF TUMORS OF CARTILAGINOUS ORIGIN ON THE BASIS OF RADIOLOGICAL TISSUE DIAGNOSIS. Buraczewski, Janusz. Warsaw, School of Medicine, 1964. (In Polish).

Thesis.

Classification of calcification and ossification and their analysis as the basis of macroscopic radiological tissue diagnosis is discussed. The recognition of cartilaginous tissue and the possibility of differentiating it from other types of tissue and the classification and differential recognition of benign tumors of cartilaginous origin are discussed. Differentiation of pathological bone-cartilaginous excrescences as distinct pathological units is introduced. The classification and differentiation of malignant tumors of cartilaginous origin is discussed on the basis of the radiological analysis of cartilaginous tissue. The problem of the structure of heterogeneous tumors containing the cartilaginous component is mentioned. The section on multiple tumors of cartilaginous origin contains a discussion of the individual pathological units. The problem of histologically heterogeneous multiple tumors is considered. The tactical problems and proper clinical procedures for cartilaginous tumors are outlined. (JPRS)

45741 BRAIN ATROPHY IN X-RAY PICTURES OF THE SKULL. Kusmiderski, Jozef. Krakow, School of Medicine 1965. (In Polish).

Thesis.

The experiment was designed to define the radiological symptoms of brain atrophy detectable in x-ray pictures of the skull. Angiographic and general x-ray pictures of 440 patients examined for brain atrophy at the Neurology Department of the Neurosurgical Clinic, School of Medicine in Krakow were used in the work. The clinical picture and x-ray photographs were used as documents in the cases examined. The patient's age at which the disease developed was a decisive factor in the bone transformations in the skull characteristic of brain atrophy. Bone changes in the skull occurred more frequently and were more easily detectable in asymmetrical atrophy. The material contains hitherto undescribed radiological symptoms accompanying brain atrophy. (JPRS)

45742 RADIOLOGICAL EXAMINATION OF THE RESPIRATORY FUNCTION OF THE LUNGS USING A DEVICE OF OWN DESIGN. Zamojda, Bazyli. Bialystok, Poland, J. Marchlewski School of Medicine, 1965. (In Polish).

Thesis.

A description is given of the development of a new method for investigating the respiratory function of the lungs on the basis of a device of own design that enables the taking of x-ray pictures of the thoracic cavity in various phases of respiration. This permits the evaluation of the ventilating capacity of the individual parts of the lungs, and determination of changes in the vital capacity of lungs or each lung separately, as well as surface changes on the basis of radioplanimetric investigations. (JPRS)

45743 DEUTSCHER ROENTGENKONGRESS 1966. BERICHT UEBER DIE 47. TAGUNG DER DEUTSCHEN ROENTGENGESELLSCHAF 18.–21. MAI 1966 IN BERLIN. TEIL B. STRAHLENBEHANDLUNG UND STRAHLENBIOLOGIE. (German Roentgen Congress 1966. Report on the 47th Conference of the German Roentgen Society on May 18–21, 1966 in Berlin. Part B. Radiation Treatment and Radiation Biology). Oeser, Heinz. Strahlentherapie, Sonderbaende, 64: 1-331(1967). (CONF-660566).

The 53 contributions presented at the 47th conference of the German Roentgen Society are compiled. The aspect of radiation treatment and radiation biology considered was problems of medical cooperation in radiology, application of radiobiological data in radiotherapy, radiation therapeutic methods, results of experimental radiobiology, radiological techniques, and chemotherapy and radiation treatment. Individual abstracts were prepared for 28 of the papers. (J.S.R.)

For abstracts of individual chapters see: 45521, 45604–45606, 45744–45765, 45796, and 45797.

45744 RADIOBIOLOGY AND RADIOTHERAPY. Zuppinger, Adolf (Univ., Bern). Strahlentherapie, Sonderbaende, 64: 9-23(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

The close cooperation needed between experimental radiobiologist and radiotherapist is illustrated by reports of several cases of radiotherapy and their long range results. The radiobiological problems of greatest significance for the radiotherapist that are still unsolved include Ca uptake and P incorporation after irradiation. 38 references. (J.S.R.)

45745 APPLICATION OF RADIOBIOLOGICAL KNOWLEDGE TO RADIOTHERAPY FROM THE VIEW POINT OF EXPERIMENTALLY ACTIVE BIOLOGY. Rausch, Ludwig (Univ., Giessen, Ger.). Strahlentherapie, Sonderbaende, 64: 24-62 (1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

After a review of quantitative cytology and cell population kinetics, three areas were described in which radiobiology and radiotherapy of malignant tumors are extensively connected; definition of the concept radiosensitivity, healing and recovery, and relation between tumor and host under increase of O_2 consumption. The radiobiological principles and their application to therapy were then discussed in detail. (180 references.) (J.S.R.)

45746 FRACTIONATION IN TIME AND SPACE. Kuttig, Helmut (Univ., Heidelberg). Strahlentherapie, Sonderbaende, 64: 69-73(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

The results of clinical studies on the effect of the sieve irradiation method are summarized. The therapeutic results obtained in the sieve irradiation of bladder carcinomas, ovary carcinomas, and bronchial carcinomas are illustrated. (J.S.R.)

45747 TWO-COMPONENT THEORY OF RADIATION AND ITS SIGNIFICANCE FOR RADIOTHERAPY. Wideroee, Rolf. Strahlentherapie, Sonderbaende, 64: 94-104(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

It was shown how a two component theory of irradiation with certain assumptions on the increase of cells after irradiation is capable of forming a bridge between the radiobiological cell culture studies and radiotherapy. It makes it possible to explain irregular results of radiotherapy and to understand the favorable effect of high energy electrons used in high single doses. (tr-auth)

45748 THE PROBLEMATICS OF RADIOTHERAPY OR OPERATIONS IN LARYNX CARCINOMAS SINCE INTRODUCTION OF TELECOBALT BEAMS. Bohndorf, Werner; Dickhaeuser, Karlheinz (Univ., Wuerzburg, Ger.). Strahlentherapie, Sonderbaende, 64: 105-11(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

Beginning with the treatment results in larynx carcinomas between the years 1945 and 1963 especially the results after primary telecobalt therapy and secondary operations, a study was made to determine how frequently a secondary operation must be performed because of insufficient retrogression of the tumor. The contribution of radiotherapy and operations to the cure ratio were also investigated. It can be demonstrated that in glottis tumors, 76% of the patients can be cured by telecobalt therapy alone. In supraglottis tumors the three year healing rate is dependent on the subsequent laryngectomy. A comparison between the operations alone and operations after preliminary irradiation showed that the cure rate of operations after preliminary irradiations is significantly higher than for operations alone. The primary radiation treatment of larynx carcinomas with ultrahard radiation can be seen as a method of value. (tr-auth)

45749 THE RELATION BETWEEN RADIATION DOSE AND LEUKOCYTE NUMBER IN THE PERCUTANEOUS RADIOTHERAPY. Schoen, Detlev (Univ., Tuebingen, Ger.). Strahlentherapie, Sonderbaende, 64: 112-21(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

With the help of leukocyte concentrations in the peripheral blood of 67 patients who were irradiated post operatively for hypernephroma and of 51 patients who were irradiated for inoperable bronchial and esophageal carcinomas, the dose-effect relations were analyzed. The following parameters were considered; average daily dose, body stature, leukocyte initial value, preliminary irradiation, radiation quality, sieve irradiation, pendulum irradiation, cytostatic pretreatment, and simultaneous irradiation of the spleen. The comparison of the dose-effect curves of abdomen and thorax irradiation showed that the integral dose as reference magnitude was suitable only in combination with biological proportionality constants. (tr-auth)

45750 NEW RADIOBIOLOGICAL KNOWLEDGE FOR THE IMPROVEMENT OF RADIOTHERAPY. Schumacher, Werner (Institut fuer Strahlentherapie und Nuklearmedizin im Staedtishen Rudolf-Virchow-Krankenhaus, Berlin). Strahlentherapie, Sonderbaende, 64: 122-9(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

The results of the latest radiobiological studies and suitable animal experimental investigations lead to a change of the previous rigid irradiation schemes. The single dose was increased, in order to improve the dose-effect relation, corresponding to the radiosensitivity of the tumor cells. The fractionation time interval was increased in order to attain sufficient recovery of the healthy tissue irradiated simultaneously. The optimum interval was determined from percent tumor cell damage, tumor growth rate, and recovery of the healthy tissue. When the total irradiation time was lengthened, an improved radiation tolerance of the healthy tissue was obtained with the possibility of therapeutically irradiating less sensitive tumors. The required total tumor dose was established with consideration of the following factors: radiosensitivity of the tumor cells, tumor size, growth rate of the tumor cells, and nourishment and blood flow through the tumor. Optimum radiation therapy and improved utilization of the new possibilities of megavolt therapy was demonstrated by extensive adaptation of the physical assumptions on the biologically effective factors for each individual tumor situation. (tr-auth)

45751 NEW STUDIES ON THE BEHAVIOR OF ENZYMES FOR THE GLUTATHIONE REDUCTION IN RADIOTHERAPY. Gerhardt, Paul (Univ., Tuebingen, Ger.). Strahlentherapie, Sonderbaende, 64: 136-41(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

The activity of glutathione and of the ferments separated in the reduction of oxidized glutathione was determined in patients subjected to radiotherapy. The results showed no alteration of glutathione content or glutathione stability after radiotherapy. It was concluded that the enzymes for glutathione reduction in the normal erythrocytes are present in excess so that in radiotherapeutic doses, as opposed to lethal whole body doses, the glutathione content of the cells can be maintained in normal concentrations. (J.S.R.)

45752 PROBLEMATICS OF X IRRADIATION IN HYPOTHERMIA. Fochem, Karl (Univ., Vienna). Strahlentherapie, Sonderbaende, 64: 142-3(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

Two cases are cited to show the effects of hypothermia in preventing radiation sickness following radiotherapy of carcinomas and sarcomas. (J.S.R.)

45753 INVESTIGATIONS ON IRRADIATION IN LOCAL HYPOTHERMIA AND LOCAL IRRADIATION IN GENERAL HYPOTHERMIA. Reinhardt, Kurt (Roentgenabteilung des Kreiskrankenhauses Voelklingen/Saar, Ger.). Strahlentherapie, Sonderbaende, 64: 144-6(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

The results of local irradiation of rats in general hypothermia suggested the possibility of transferring this technique to human radiotherapy. The irradiation of a bone sarcoma on the leg in local hypothermia was studied. The irradiation technique used was described in some detail. The treatment had to be discontinued as extreme pain resulted. Only temporary therapeutic results were obtained. (J.S.R.)

45754 ISOTOPE STUDIES ON THE EFFECT OF ENERGETIC BEAMS ON THE ERYTHROCYTE LIFE TIME AND ITS MODIFICATION BY PROTECTIVE SUBSTANCES. Pabst, Hans Werner; Hahn, Barbara; Klemm, Johannes (Univ., Munich). Strahlentherapie, Sonderbaende, 64: 147-50(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

The whole body irradiation of rabbits with 280 R leads to a decrease of the erythrocyte life time determined with ^{32}P-labeled diisopropyl fluorophosphate. The addition of yeast exerts a partial radioprotective effect but Co salts and essential phospholipids showed no protective effects. Earlier results with ^{51}Cr methods that indicated a protective effect by Co compounds were caused by the inhibition of the ^{51}Cr elution and thus showed a false protective effect. (tr-auth)

45755 FURTHER INVESTIGATIONS ON THE RADIOPROTECTIVE EFFECT OF ERYTHROPOIETIN. Mauss, Hans-Joerg; Kuenkel, Hans Adam; Mayr, Henrik-Juergen (Univ., Hamburg). Strahlentherapie, Sonderbaende, 64: 155-9(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

Erythropoietin leads to a significant compensation of the radio-induced inhibition of erythropoiesis when it is administered before and after irradiation. The compensatory effect of erythropoietin was largest when the highest possible erythropoietin dose was introduced into the erythropoietic system ~24 hr before irradiation. (tr-auth)

45756 ELECTRONICALLY CALCULATED EFFICIENCY FACTORS AND THEIR COMPARISON WITH CLINICAL OBSERVATIONS DURING AND AFTER RADIOTREATMENT. Frischkorn, Rolf; Rosenow, Ulf (Univ., Goettingen, Ger.). Strahlentherapie, Sonderbaende, 64: 165-8(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

Efficiency factors in radiotherapy were calculated using an IBM-7090 computer. The isodoses calculated for three cases are presented. The calculated dose distribution corresponded very well with clinical observation. (J.S.R.)

45757 HISTOCHEMICAL AND BIOCHEMICAL STUDIES OF THE REACTION OF CONNECTIVE TISSUE CONSTITUENTS (MUCOPOLYSACCHARIDE) AFTER EFFECTS OF IONIZING RADIATION. Kaercher, Karl Heinz (Univ., Heidelberg). Strahlentherapie, Sonderbaende, 64: 169-78(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

On the basis of histochemical and biochemical research, the importance of connective tissue research in radiotherapy was indicated. On the basis of previous studies the possibility of using these research methods in the evaluation of the interrelation of tumors and surrounding connective tissue, the effect of individual dose and fractionation, the RBE of various radiation types, and the individual defensive capacity of the organism was discussed. The influence of histochemical and biochemical research on acid mucopolysaccharide, and ferment studies, on the evaluation of subsequent reactions during radiotherapy of malignant tumors was reported. It will be possible in the future to obtain insight into the subsequent reactions of radiotherapy both in the tumor itself and also in the surrounding connective tissue. This is important both for subsequent evaluation of the radiotherapy and for estimation of the secondary effects and damage possibilities. (tr-auth)

45758 SIGNIFICANCE OF THE EXPERIMENTAL FETAL DAMAGE RESEARCH FOR RADIOBIOLOGY AND AN IMPROVED RADIOTHERAPY. Trautmann, Johannes (Staedtische Krankenhaus Moabit, Berlin). Strahlentherapie, Sonderbaende, 64: 191-2(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

The importance of obtaining histological data on the normal chronological development of the fetus with corresponding data on the fetus under whole body irradiation conditions is stressed. These data are necessary for the evaluation of the effects of radiotherapy on infants and growing children. (J.S.R.)

45759 SUBMICROSCOPIC TUMOR CELL CHANGES AFTER THERAPEUTIC RADIATION EFFECTS. Chone, Bruno (Univ., Heidelberg). Strahlentherapie, Sonderbaende, 64: 197-202 (1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

Electron microscopic results on tumor cell substrates are reported. These data were obtained within the framework of radio-

therapy and were evaluated in conjunction with cytomorphological studies. The higher structure resolution in the electron beam permits not only a much earlier and more accurate localization of the cellular radiation damage but facilitates an insight into the intracellular metabolic patterns. (tr-auth)

45760 PRIMARY AND SECONDARY RADIATION EFFECTS OF FAST ELECTRONS IN THE SURFACE AREA. Frost, Dietrich (Staedtische Rudolf-Virchow-Krankenhauses, Berlin). Strahlentherapie, Sonderbaende, 64: 209-12(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

The results obtained in studies on the primary and secondary radiation effects of fast electrons in the surface area are reviewed. Discrepancies between various studies are cited to indicate the areas where additional studies are necessary. (J.S.R.)

45761 A DOSIMETRIC SCHEME FOR INTERSTITIAL GAMMA THERAPY (POINT, LINEAR, AND FLUID EMITTER). Busch, Manfred (Univ., Freiburg i. B.). Strahlentherapie, Sonderbaende, 64: 213-18(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

From the graphic representation of the linear relation between activity and surface of the m plantate, a general formulation of the dosimetric rule for interstitial γ therapy, was derived. The formulation is independent of geometric parameters with the exception of the tumor surface. (J.S.R.)

45762 RADIOBIOLOGICAL PRINCIPLES OF RADIOTHERAPY. Tubiana, Maurice (Paul-Brousse-Krankenhauses, Villejuif, France). Strahlentherapie, Sonderbaende, 64: 228-33(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

The radiobiological principles of radiotherapy are summarized on the basis of a literature review. 31 references. (J.S.R.)

45763 RESULTS OF BONE MARROW TRANSPLANTATION AFTER WHOLE-BODY IRRADIATION IN MEN. Schwarzenberg, L.; Amiel, J. L.; Cattan, A.; Mathe, G.; Schlumberger, J. R.; Schneider, M. (Paul-Brousse-Krankenhauses, Villejuif, France). Strahlentherapie, Sonderbaende, 64: 265-7(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

The polymerization of bone marrow transplantations after whole body irradiation was reported for 21 patients. Five of the patients died soon after x irradiation. A sixth recovered from panmyelophtisia before death. In the 15 remaining patients the transplanted bone marrow was accepted although there were varying courses of illness following. Eight of these patients died with acute secondary syndrome and two additional ones died of subacute secondary syndrome. The eleventh patient died 20 months after transplantation during the course of chronic secondary syndrome. Only four patients survived the phase of chronic secondary syndrome and of these four, three died of leukemia. Only one of the 21 patients is still living and in good health. The reaction patterns of the patients after bone marrow transplantation are outlined. (J.S.R.)

45764 COMPARATIVE STUDIES ON THE TREATMENT OF CHRONIC MYELOID LEUKEMIA WITH X RAYS AND MYLERAN. Bousser, J.; Bilski-Pasquier, G.; Blanc, C. (Krankenhauses Hotel Dieu, Paris). Strahlentherapie, Sonderbaende, 64: 271-5 (1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

A comparative study was made of the effects of x radiation and myleran on the treatment of chronic myeloid leukemia in 76 patients under clinical observation from the beginning of the sickness up until death. For statistical evaluation the patients were divided into four groups: patients treated with x radiation alone, patients treated first with radiation and then with myleran, patients who were treated alternately with x radiation and myleran, and patients who received myleran alone. The first group of patients had a survival time in the arithmatic mean of 20.93 months with a median of 25.75. For the second group there was a mean value of 49.63 at a median of 40.5. The third group showed a mean of 31.63 months with a median of 31.75. The fourth had a mean of 33.28 and a median of 33.5. The scattering widths were respectively 22, 30.97, 17.86, and 19.7 months. These results showed that chemotherapy with myleran can lengthen the statistical life expectancy of the patient. The mean remission length for the patients was 4.13 for the first group, 9.94 for the second group, 6.45 for the third group, and 7.26 months for the fourth group. No evaluation of these results was possible. (J.S.R.)

45765 EFFECT AND EFFECT DIFFERENCE OF CYTOSTATICS AND IONIZING RADIATION ON TUMOR CELLS IN DISCHARGES. Thom, Reinhard (Freie Univ., Berlin). Strahlentherapie, Sonderbaende, 64: 310-18(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

The effects of ethyleniminobenzoquinone on tumor cells in exudates from tumors were investigated; results were compared to those obtained with radiogold therapy. The cytostatic agent reacted within 10 min to 4 hr after intracavitary injection. After 12 to 24 hours the majority of the tumor cells were necrotic. The onset of necrosis was accompanied by a massive invasion of phagocytic granulocytes and histocytes. With radiogold therapy the reduction in tumor cells was protracted over several days, there was a high yield of cell detritus, and the phagocytic response of the granulocytes and histocytes occurred at a later time. A detailed discussion of electron microscopy studies on the malignant exudate from a patient with retothel sarcoma in the pelural cavity is presented. (J.S.R.)

45766 RADIOBIOLOGIE APPLIQUEE. TOME I ET II. (Applied Radiobiology. Volumes I and II). Loiseleur, J. (ed.). Science et Techniques d'Aujourd'hui. Paris, Gauthier-Villars, 1966. 1005p.

Twenty-three monographs analyzing in detail the present bases of applied radiobiology are presented. Each monograph is followed by an extensive bibliography. The volumes are divided into five sections: physics, mechanisms of cellular actions, histopathological effects of radiations, restoration and protection, and experimentation with isotopes and labeled elements. Individual abstracts were prepared for the monographs. (J.S.R.)

For abstracts of individual chapters see: 45527–45534, 45639, 45640, 45767–45770, 45827–45833, 45850, and 45851.

45767 RESTORATION OF RADIOLESIONS. Duplan, J.-F. (Institut Pasteur, Paris). pp 697-756 of Radiobiologie Appliquee. Tome II. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

The spontaneous or provoked restoration of radiolesions induced by ionizing radiation are studied. The spontaneous restoration on the cellular level, restoration of tissues and organs, restoration after whole-body irradiation, and restoration of the lethal effect are considered. Provoked restoration using chemical, biochemical, and subcellular agents is discussed. Restoration by means of living cells, as in cellular grafts, is described. 160 references. (J.S.R.)

45768 RADIOVACCINATION AND CURATIVE TREATMENT OF CUTANEOUS RADIOLESIONS. Loiseleur, J (Institut Pasteur, Paris). pp 757-74 of Radiobiologie Appliquee. Tome II. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

The successive irradiation of several different cutaneous fields on the same animal causes a radiovaccination state characterized by the progressive decrease of each of the radiolesions. Moreover the serum of this radiovaccinated animal becomes curative and can be used for the treatment of radiolesions by injection into an animal with radiolesions. The radiolesion provoked by the irradiation with a single cutaneous field in rabbits and rats is described; the phenomenon of radiovaccination is described and illustrated. A series of experiments with rats were made to define the mechanism of radioimmunization. The results established a confusion between the DNA constituents and the restoration factor. Factors determining outcome of radiovaccination are the following: lysis of DNA in ruptured cells, diffusion of restoration factors in intact cells, and diffusion of restoration factors in injured cells. (J.S.R.)

45769 THE FUNCTIONAL EXPLORATION OF THE THYROID GLAND BY RADIOISOTOPES. Peyrin, J.-O.; Berger, M. (Faculte de Medecine et de Pharmacie, Lyon). pp 869-915 of Radiobiologie Appliquee. Tome II. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

Radioactive iodine makes it possible to study qualitatively and quantitatively the following steps in the metabolism of iodine: uptake of the circulating ionic iodine by the thyroid gland, synthesis of thyroid hormones by the gland, secretion and transport of these hormones to the tissues, and the use of the thyroid hormones by the tissues. After indicating the general rules for the use of radioiodine as a tracer, each of these metabolic steps is discussed. (J.S.R.)

45770 GENERAL CONCEPTS ON THE THERAPEUTIC UTILIZATION OF ARTIFICIAL RADIOISOTOPES. Chevallier, Andre (Faculte de Medecine, Strasbourg). pp 917-54 of Radiobiologie Appliquee. Tome II. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

The general concepts in the application of artificial radioisotopes used internally in the form of solutions or of suspensions are studied considering the various modalities used. The therapeutic use of radioiodine solutions and of soluble radiophosphates administered orally or by intravenous or intra-arterial injection is outlined. The administration of insoluble radioisotopes in colloidal suspension, specifically ^{198}Au and chromium radiophosphate, by the same methods is also studied. The injection of infiltration in situ either in a natural cavity or at a specific point of the organism is also considered. The injection of insoluble colloidal radioisotopes in the pleural or peritoneal cavities is discussed. The interstitial injection of radiocolloids is described. Lymphatic migration of radiocolloids and its consequences are discussed. Various applications of in situ administration are considered. (J.S.R.)

45771 PROTON IRRADIATION OF AN EXPERIMENTAL MURINE BRAIN TUMOR. Stratton, K.; Anderson, A. (Massachusetts General Hospital, Boston. Harvard Medical School, Boston). 14p. (CONF-660212-9). ORAU. Gmelin, AED-CONF-66-016-9.

From Radiation Research Society, 14th Annual Meeting, Coronado, Calif.

Malignant tumors were induced in brains of mice using methylcholanthrene, and the effects of proton irradiation and x irradiation on the tumors were studied. The radioprotective agents, AET and IVDR, were administered, and it was noted that IVDR reduced the growth rate of the tumors. Results are shown by means of graphs. (H.L.W.)

Radiation Effects on Animals

Refer also to abstracts 45508, 45539, 45595, 45606, 45641, 45679, 45700, 45714, 45717, 45718, 45720, and 47026.

45772 (ACRH-27) SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION. Jacobson, Leon O.; Doyle, Margot (eds.) (Argonne Cancer Research Hospital, Chicago, Ill.). Mar. 1967. Contract AT(11-1)-69. 137p. Dep. CFSTI.

ESTROGENS — effects on metabolism of sulfobromophthalein sodium, in rats
DISEASES — etiology of juvenile gout, effects of uric acid production on
DISEASES — etiology of Wilson's, effects of uric acid production on
MAN — metabolism of uric acid in, tracer study of
MAGNESIUM — metabolism in rats, effects of dietary deficiency on,
INTESTINE — magnesium uptake by, of rats, tracer study of
IMMUNE REACTIONS — radiation effects on, in rat spleen, effects of repopulation with lymphocytes on x
X RADIATION — effects on immune reactions in rats, effects of splenic shielding on
CELLS — migration of spleen, effects of, on immune reactions in rats
TRANSFERASES — activity of, effects of adsorption on anion exchanger on
BACTERIA — Escherichia coli, extracts from, activity of ribonucleic acid sulfur-transferase in
RIBOSOMES — protein structure of isolated, from cells of Escherichia coli, liver, and reticulocytes, tracer study of,
ENZYMES — effects on ribosomes isolated from Escherichia coli, liver, and reticulocytes
ERYTHROPOIESIS — radiation effects on, in mice, effects of erythropoietin and previous exposure on x
ERYTHROPOIETINS — effects on erythropoiesis in x-irradiated mice
X RADIATION — effects on erythropoiesis in mice, effects of erythropoietin and previous exposure on
SPLEEN, BONE MARROW — radiation effects on stem cell compartment in mouse, β and x
ERYTHROPOIETINS — purification of, method for
BONE MARROW — metabolism of heme in cultures of, from patients with polycythemia, effects of erythropoietin on
STANDARDS — Atomic Energy Commission, for use of radioisotope-labeled pharmaceuticals
STANDARDS — National Institutes of Health, for use of radioisotope-labeled blood products
STANDARDS — Food and Drug Administration, for use of accelerator-produced radioisotope-labeled pharmaceuticals
RADIATION — dosimetry in radioisotope-labeled pharmaceuticals
ELECTRONS — dosimetry of beams of high energy
STANDARDS — Subcommittee on Radiation Dosimetry of American Association of Physicists in Medicine, for dosimetry of high-energy electrons
RADIATION DOSIMETRY — standards for radioisotope-labeled pharmaceuticals; standards for high-energy electron beams
SCINTISCANNING — use of multi-detector scanner and technetium-99 for brain,
RADIATION DETECTORS, SCINTILLATION — design for brain scanning
COLLIMATORS — design for use with scintillation detectors in brain scanning (C.H.)

45773 (AD-635661) BEHAVIORAL EFFECTS OF RADIO-LESIONS IN THE BRAIN OF THE PIGEON (COLUMBA LIVIA). APPENDIX I. Final Technical Report. Fabricius, Eric (Stockholm Univ. (Sweden). Dept. of Zoology). June 25, 1963. Contract AF61(052)-138. 14p. CFSTI.

Brain lesions produced by local irradiation with high energy protons were used to study the role of the cerebral hemispheres in the control of behavior in pigeons. Complete intersection of the cerebral peduncles resulted in a total loss of spontaneous feeding and drinking, escape responses and social behavior. Balancing movements and an advanced visual control of locomotion persisted, including the ability of avoiding obstacles during flight and of precision landing. Transsection of the cerebral peduncles except part of the tractus occipito-mesencephalicus gave similar symptoms, except that escape responses persisted for a longer period. In birds with more rostral lesions, sparing the posterior portion of the lateral forebrain bundle as well as the tractus occipito-mesencephalicus, the ability of spontaneous eating and drinking persisted, as well as the escape responses, and even social behavior was observed. Transsection of the median forebrain bundle (tractus septo-mesencephalicus) produced no obvious behavioral changes, except for some very slight abnormalities in copulatory behavior in one bird and a slight impairment of retention in learning tests in another individual. However, these effects could as well be described to damage to some paleostriatal tissue included in the lesions. (auth) (TAB)

45774 (AD-641331) PERFORMANCE OF RHESUS MONKEYS DURING CONTINUOUS LOW-LEVEL GAMMA RADIATION: AN EXPLORATORY STUDY. Braun, Robert G.; Farrer, Donald N.; Zappini, William; Crook, Guy H. (Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.). Oct. 1966. 29p. (ARL-TR-66-18). CFSTI.

Six rhesus monkeys, two males and four females weighing 4.8 to 5.3 kg. were trained to perform four operant tasks (continuous avoidance, response time following an auditory cue, response time following a visual cue, and a fixed ratio task). Baseline performance was obtained in the laboratory during a 30-day simulated exposure situation. The exposure phase involved a 10-day preexposure baseline, 10 days of continuous exposure to 2R per hour gamma radiation, and a 10-day post-exposure follow-up assessment of performance. A 30-day follow-up was also conducted 60 days following the exposure phase. No performance diminutions were discovered on the aversively motivated tasks, but a performance diminution in the food rewarded fixed ratio task occurred during the radiation exposure. All the animals recovered shortly after the exposure and still appeared normal eight months later. (auth) (TAB)

45775 (AD-651750) A STUDY OF THE PRODUCTION OF CHORIORETINAL LESIONS BY THERMAL RADIATION. Final Report, October 15, 1965–March 15, 1966. Alexander, T. A.; Bessey, R. L.; Lawler, E. R. Jr.; Bruce, W. R.; Allen, R. G. Jr. (Technology, Inc., San Antonio, Tex. Life Sciences Div.). Dec. 1966. Contract AF41(609)-2906. 15p. (DASA-5710; SAM-TR-66-105). CFSTI.

Chorioretinal burns have been systematically produced in pigmented rabbits under carefully controlled laboratory conditions. Lesions were produced by high-intensity light flashes ranging in duration from 165 microsec to 250 msec and with image diameters that ranged from 1.0 to 0.11 mm. From these measurements, relations were obtained between exposure duration and threshold irradiance for the production of 5-minute minimal lesions. (auth) (TAB)

45776 (ORAU-101, pp 8-12) THE EFFECT OF TOTAL-BODY IRRADIATION ON HUMAN CHROMOSOMES. I. CYTOGENETIC STUDIES OF THE PERIPHERAL LEUKOCYTES SEVEN YEARS AFTER TOTAL-BODY IRRADIATION. Goh, Kong-oo (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

Chromosome aberrations were found in leukocytes in the peripheral blood of six men 7 yr after accidental exposure to mixed fast neutrons and γ radiation in whole-body doses ranging from 22.8 to 365 rads. Seventy-nine (15.4%) abnormal cells and 46(9%) x1 cells were seen. A total of 116 chromosome breaks were found in 512 metaphases. The chromosome breaks included fragments and translocations in all patients, dicentrics and ring chromosomes in four of the patients, and smaller G chromosomes in all

patients. The frequency of chromosome abnormalities was independent of dose. (C.H.)

45777 (ORAU-101, pp 14-17) A STUDY OF INFECTIONS IN IRRADIATED PATIENTS. Balish, Edward (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

Preliminary studies showed that from 1 to 12 days after a dose of 100 R whole body γ radiation the fecal, gastric, and nasal microflora are altered. A rise in the pH of the gastric secretions was observed and may be a factor in the shift in the gastric microflora. The implications of the findings in the incidence of infections in animals and man after exposure to sublethal and lethal doses of whole-body radiation are discussed. (C.H.)

45778 (ORAU-101, pp 18-23) HEMATOLOGIC EFFECTS OF TOTAL-BODY IRRADIATION IN THE HUMAN BEING. Andrews, Gould A.; Lushbaugh, C. C.; Kniseley, Ralph M.; White, D. A. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

Hematologic data on patients with chronic leukemia, acute leukemia in relapse, polycythemia vera, and various types of advanced neoplasms exposed to a single whole-body dose of γ radiation ranging from 50 to 473 R are reviewed. It is pointed out that the effects are not those that would be expected in normal persons, but the data have value in understanding the abnormal hematopoietic physiology of patients with blood diseases and some value in indicating general hematologic responses to whole-body irradiation. The data show some underlying patterns, even though there is pronounced variation depending on the disease state. The effect of radiation was shown to always depress hematological values in some degree and in general the levels of abnormal cells were more easily depressed than those of normal cells. Platelet values were uniform in all the diseases. In patients with chronic leukemia, 50 R produced a distinct depression in the leukocyte count and the time course of the depression of lymplocyte values was quite similar to that of ganulocyte values, a gradual fall during a period of about 3 weeks. More striking responses were observed in children than in adults. Data for normal persons show it is difficult to detect any effects of radiation doses up to 50 R on the blood values and at higher doses lymphocyte depression occurs promptly and granulocyte depression is more gradual. (C.H.)

45779 (ORAU-101, pp 23-7) RADIATION EXPOSURE-RATE STUDIES ON SPECIFIC-PATHOGEN-FREE MICE. Gengozian, Nazareth; Allen, Elizabeth; Carlson, D. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

The importance of exposure rate on the therapeutic effectiveness of foreign bone marrow transfusions demonstrated previously in mice was confirmed using specific-pathogen-free mice injected with rat bone marrow after exposure at dose rates varying from 4 R/min to 53 R/min to doses varying from 900 to 1200 R. It is postulated that the greater percent of survival obtained with the exposure rate of 53 R/min in both conventional and pathogen-free mice may merely reflect the greater suppression of the host's immune mechanisms resulting in more benefit from the foreign marrow graft. (C.H.)

45780 (ORAU-101, pp 27-30) HISTOLOGIC CHANGES IN MARROW AFTER TOTAL-BODY IRRADIATION OF MARMOSETS: A QUANTITATIVE STEREOLOGIC EVALUATION. Nelson, Bill M.; Lothrop, Martha L.; Gengozian, Nazareth (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

The marmoset Saguinus fusciollis is extremely sensitive to whole-body γ irradiation, having an $LD_{50/30}$ of 200 R. Results are reported from a quantitative stereologic evaluation of histologic changes in femoral bone marrow of marmosets after whole-body exposure to doses of γ radiation ranging from 100 to 800 R. Depression of hemopoiesis was seen in the marrow of all animals that died during the first month after irradiation, but bone marrow recovery was observed in animals that died much later after exposure to 100 R. No benefit from marrow infusions was evident after exposure to 400 R. Exposure to 600 and 800 R apparently permitted a homograft with prolongation of life and development of hemopoietic activity in the marrow, although none of the animals recovered before death. (C.H.)

45781 (ORAU-101, pp 30-4) VASCULAR RADIATION SYNDROME. Lushbaugh, C. C. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

A retrospective study of the case histories of two nuclear criticality accident radiation victims showed that both showed signs of extreme hypotension, widespread vascular damage, and shock that resulted in death within two days. The accidents were basically similar criticality excursions that resulted in an integrated whole-body dose of about 4900 rads to one patient and about 8800 rads to the other patient. The doses to the heart were two or more times larger than the whole-body dose. The clinical courses were so similar that it was concluded that the same morphological damage occurred in both cases. A study of clinical data and post-mortem findings led to the conclusion that peripheral and organic vascular damage was the dominant radiation lesion underlying the hypotensive shock and rapid death. (C.H.)

45782 (ORAU-101, pp 34-6) ABSENCE OF SODIUM LOSS AFTER MASSIVE TOTAL-BODY NEUTRON EXPOSURE OF RATS. Lushbaugh, C. C.; Hodges, H. D.; Yarbrough, M. C.; Gibbs, William D. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

Three groups of rats were exposed to fission neutrons; two groups received 100 rads/rat and one group received 1200 rads/rat. In all rats exposed to 1200 rads death occurred between 68 and 75 hrs after exposure and mucosal denudation of the small intestinal was evident. One 100 rad group was allowed food and water ad libitum, and the other group was pair-fed with the 1200 rad group. The rats in all groups were whole-body counted, and individual retention curves were determined for neutron-activated ^{24}Na. When all of the 1200 rad group were dead, the others were killed and residual ^{24}Na in the gastrointestinal tract, liver, and other tissues was determined. No significantly different loss in body weight occurred in the 1200 rad rats in comparison with the 100 rad pair-fed controls. The whole-body ^{24}Na retention curves showed that the 1200 rad rats did not develop a Na leak. The 1200 rad rats and the 100 rad rats pair-fed with them lost ^{24}Na at a much slower rate than the 100 rad rats allowed free access to food. It was concluded that electrolyte loss is not the basic lethal mechanism in the gastrointestinal syndrome in rats. (C.H.)

45783 (ORAU-101, pp 53-5) COMPUTER STUDY OF THE HEMOPOIETIC SYSTEM OF RATS RECOVERING FROM TOTAL-BODY IRRADIATION. OKunewick, James P.; Kretchmar, A. L. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.).

A mathematical model of hematopoiesis was used to study the effects of 100 R whole-body x radiation on the uptake of ^{59}Fe by erythrocytes in rats. A computer method was used for data analysis. (C.H.)

45784 (TID-23956) THE EFFECTS OF RADIATION AND IMMUNOSUPPRESSIVE DRUGS ON ANTIBODY FORMATION AND ALLERGY. Progress Report, December 1, 1966-August 10, 1967. Jennings, B. R. (Tennessee Univ., Memphis). Aug. 17, 1967. Contract AT(40-1)-3489. 18p. Dep. CFSTI.

Experiments were performed to characterize the inhibition of the secondary immune response by actinomycin D and x radiation. Mice of the Hale-Stoner strain that were free of the specific pathogen were used. The animals were exposed first to aluminum phosphate-adsorbed tetanus toxoid (APTT), and at least 21 days later, they were exposed to fluid tetanus toxoid (FTT). Actinomycin D was administered intra-abdominally before, at the time of, and after the antigenic stimulus. The number of international units (I.U.) of tetanus antitoxin (TAT) was determined from analysis of pooled blood samples from the three groups of mice. Mice were exposed to a 100R dose of x radiation. Data on the extent of antibody synthesis inhibition in the three groups of mice are presented in tabular form. (W.E.B.)

45785 EXAMINATIONS ON THE LONG-RANGE ACTION OF RADIOGENIC PRODUCTS. PART II. INFLUENCING OF ^{32}P UPTAKE IN JENSEN SARCOMA IN VITRO BY ADDITION OF PEROXIDES TO THE NUTRITIVE MEDIUM. Rose, H. (Humboldt-Univ., Berlin). Radiobiol. Radiother., 8: 331-4(1967). (In German).

The concentrations of peroxides (hydrogen peroxide and n-propylhydroperoxide) that are necessary to obtain a significant retardation of ^{32}P-uptake by explanted Jensen-sarcoma in serum-containing nutritive medium are much beyond those concentrations that may be produced in organism by irradiation with sublethal doses. Owing to the high reactivity of serum of untreated as well as of irradiated rats, it was concluded that peroxides have no importance in the long-range action of ionizing radiation. (auth)

45786 RESTORATION OF MYELOPOIESIS IN MONKEYS AFTER WHOLE-BODY GAMMA IRRADIATION. Novikova, M. I. (Inst. of Experimental Pathology and Therapy, Erevan). Med. Radiol., 12: No. 7, 58-61(July 1967). (In Russian).

The features peculiar to the restoration of myeloid tissue and normalization of hematopoiesis in monkeys irradiated at doses of 580 to 650 R γ radiation were studied. In the animals irradiation caused a complete inhibition of the hematopoietic function. The first signs of restoration commonly appeared on the 10th to 17th day of radiation sickness. However, the correlations between the cellular forms during several months differed essentially from normal values. For the complete normalization of the composition of the peripheral blood and bone marrow in most monkeys nearly one year was required. (auth)

45787 MORPHOLOGICAL CHANGES OF THE LIVER AT REMOTE PERIODS AFTER WHOLE-BODY PROTON IRRADIATION. Utoplov, V. T. Med. Radiol., 12: No. 7, 52-7(July 1967). (In Russian).

In order to study changes in the liver at various periods after high-energy proton therapy, preliminary studies were carried out on 10 mongrel dogs. The irradiation was fractional (13 times), the total dose was 650 rad, the dose value was 0.3 rad/sec, and the energy was 126 MeV. The data demonstrate that in the liver of dogs 5½ months after irradiation there developed significant morphological changes, characterized by sharply marked dystrophic disturbances. (auth)

45788 METABOLIC STUDIES WITH DEUTERATED PHENOBARBITAL. Perel, James M.; Dayton, Peter G.; Tauriello, Carol L.; Brand, Leonard; Mark, Lester C. (Goldwater Memorial Hospital, New York). J. Med. Chem., 10: 371-4(May 1967).

Some H-D isotope effects in the metabolism of phenobarbital in dogs and rats were investigated using phenobarbital-p-d and phenobarbital-p-d-ethyl-d_5. The deuterated compounds were synthesized via benzyl-p-d cyanide prepared from toluene-p-d. This intermediate was utilized in the subsequent steps of the synthesis except that, for the ethyl derivative, ethyl-d_5 iodide was incorporated into the ethylcyanophenyl acetate precursor. Purity and extent of D labeling was established by several analytical criteria. It was found that the apparent rate of plasma drug level decay for all three compounds was the same, which suggests that the rupture of the para C–H bond is not rate limiting in the metabolism of phenobarbital. On the other hand, a 13 to 26% exchange of the p-d substituent was observed in vivo, which on the basis of a postulated two-step mechanism leads to a product isotope effect of four to eight. The sedative effective of the three compounds was found to be similar. (BBB)

45789 REMOTE RESULTS OF X-RAY THERAPY OF PATIENTS WITH TRICHOMYCOSIS. Malyshev, A. M. Med. Radiol., 12: No. 5, 75-6(May 1967). (In Russian).

The delayed effects of x-ray therapy for epilatory treatment of trichomycosis were investigated in 70 patients after 8 to 35 years. None of the patients exhibited any mental or physical abnormalities; the menstrual and childbearing functions of the 29 women in the group were normal. In the 37 persons subjected to a single epilatory treatment, thinning of the hair and premature graying were noted; this reduced subcutaneous reflexes and sensitivity of the exposed skin were apparent; and slight anemia and reduction in the number of leukocytes were noted in some patients. Patients receiving a divided dose exhibited normal growth of the hair. It was recommended that the dose used for epilatory treatment be divided. (TTT)

45790 INFLUENCE OF X-RAY IRRADIATION ON THE RESPIRATION OF MICE TISSUE. Ogiso, Akira (Keio Univ., Tokyo). Keio Igaku, 43: 421-36(Sept. 1966). (In Japanese).

The changes of O_2 uptake in mice organs, due to a single whole-body irradiation of x rays, were examined 2 hours to 30 days after the irradiation. The radiation doses were 50R, 100R, 300R, 500R, and 1,000 R. The organs, selected were brain, liver, spleen, kidney, small and large intestine. (1) In the parenchymatous organs, such as brain, liver, spleen and kidney, the O_2 uptake decreased with any dose between 50 and 1,000 R. (2) There were no differences in the respiration suppression by irradiation among the parenchymatous organs. (3) Intestinal canals showed higher resistance against x irradiation than parenchymatous organs. In the small intestine, the respiration increased after 50 to 100 R and decreased after 300 to 500 R. In the large intestine, the O_2 uptake increased after irradiation, especially with 100 to 500 R doses. (4) In each organ, the maximum respiration suppression occurred 24 hours to 2 days after irradiation, and the recovery began about 7 days after irradiation. (5) Even after 30 days O_2 uptake of brain did not recover to the normal value of respiration for any x ray dose. The respiration values of liver, spleen and kidney recovered to normal only after 50 R. In the intestinal canal, the respiration recovery to normal was seen even after 500 R. (6) The decrease of respiration caused by x irradiation appears to be a kind of protective reaction of the body. (7) X irradiation showed much more suppression of respiration than any other anticanceric agent. (NSA)

45791 ENERGY DEPENDENCY OF RBE OF NEUTRONS IN THE RANGE 0.43 TO 14.1 MeV. EFFECT ON DNA SYNTHESIS ON CELLULAR LEVEL. Tsuya, Akira; Okano, Shigeki (Cancer Inst. Hospital, Tokyo). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 1455-61(Feb. 1967). (In Japanese).

The relative biological effectiveness of neutron radiation of 0.43, 0.65, 1.0, 1.5, 1.8 and 14.1 MeV was studied, taking the doses for halving the labeling index of ^{3}H-thymidine as an index. Adult female mice of ddN strain and Carworth Farms BNL Stoner strain were exposed to single whole-body radiation of 250 kVp x ray, ^{60}Co gamma-ray and neutron radiation. The RBE of total bone marrow cell and red cell precursor for 0.43 MeV neutron is highest, 4.1 and 3.6 respectively, with decreasing RBE for lowering LET. The RBE of total bone marrow cell is 1.2 for 14.1 MeV fast neutron. It is considered that there exists maximum RBE of neutron in the low energy range of less than 2 MeV. The RBE of 14.1 MeV fast neutron are 1.1 and 1.2 for thymus and spleen, respectively. The RBE of 14.1 MeV fast neutron is 1.8 for the intestine. The higher RBE of the intestine suggest higher radiosensitivity of this organ than others. (auth)

45792 PATHOLOGICAL STUDIES OF 34 AUTOPSY CASES OF THE UTERINE CANCER WITH SPECIAL REFERENCE TO THE EFFECTS OF ROENTGEN AND ^{60}Co IRRADIATION. Ito, Hisaaki (Niigata Univ., Japan). Niigata Igakkai Zasshi, 80: 324-43(June 1966). (In Japanese).

Thirty-four autopsy cases of uterine cancer were investigated histologically. The mean surviving time from consultation to death of the cases was 1 year and 6 months. It was 1 year and 11 months in the operated, 1 year in the non-operated cases, 1 year and 7 months in the γ or x irradiated, and 1 year and 2 months in the non-irradiated cases. Concerning the causes of death, 10 cases died of tumor, 8 of the urinary tract disturbance, 6 of infection, 6 of cachexia, 2 of bleeding, 1 of primary pulmonary thrombosis, and 1 of an unknown cause. In 5 of the 34 cases, no tumor tissue was found; three of the five cases were postoperatively irradiated. In the 28 irradiated cases, the degeneration of tumor tissue such as the appearance of giant cells or karyolysis was marked in the primary lesion or vaginal stump. The increase of interstitial tissue was the same in the irradiated as in the non-irradiated cases, but it differed qualitatively from the latter, that is hyalinization was remarkable and fibrinoid degeneration in the wall of blood vessels was observed. Concerning the metastasis to pelvic cavity, parametrium was most frequent, followed by vagina, ovarium, urinary bladder, and rectum. In the postoperatively irradiated cases, the metastasis to urinary bladder was frequent and in the irradiated cases vaginal metastasis was frequent. In the distant metastasis, liver, lung, peritonaeum, intestinal canals, pleura, and bones were preferentially affected. In general distant metastasis was more frequent in the non-operated than in the operated cases, and more frequent in the irradiated than in the non-irradiated cases. When a massive dose over 600 R was given, metastasis was observed in few cases. In the urinary tract disturbance, 6 cases of vagino-vesical fistula were all in irradiated patients. Hydronephrosis and pyelitis were observed in over 50% of the cases. The primary cause of urinary tract disturbance was ureteral stenosis, it was rarely caused by the compression of tumor tissue, but mainly by the inflammation and the proliferation of connective tissue due to operation or x irradiation. The change of peripheral blood caused by x irradiation was restored to normal within about one month of irradiation, but the bone marrow of hip-bone included in the irradiation field was hypoplastic even 3 years after irradiation. The bone marrow of sternum far from the irradiation field was also hyperplastic, and its degree was the highest between the 11th and 28th day after irradiation. (NSA of Japan)

45793 EFFECT OF ^{60}Co (GAMMA) IRRADIATION ON THE CENTRAL NERVOUS SYSTEM. Kido, Choichiro (Aichi Cancer Center Hospital, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 27: 68-86(Apr. 1967). (In Japanese).

Gamma radiation at doses of 1,000 to 20,000 R was delivered to the head and back of 45 mature dogs. The radiation effects were observed neurologically and histologically. During irradiation, a steel cylinder (1 or 2 cm in diameter and 60 cm in length) was used for collimation of the irradiation field in order to obtain the same conditions as clinical cases in radiotherapy for tumors in the central nervous system. By connecting this cylinder to a ^{60}Co unit, irradiation fields of 1 or 2 cm in diameter were obtained. Various grade of neurological findings such as unconsciousness, transitory paraplegia, and convulsion were observed: These findings varied with the region irradiated, size of irradiation field, and dose. The symptoms were reversible with dose of 10,000 R. Radiation produced liquefaction of neural, glial, and vascular elements in tissue within the irradiation field and area adjacent to the irradiation field. The tissue changes were the same in character and intensity when the head was irradiated entirely and partially. Reactive proliferation of glial cells and degeneration of neurons were observed in the brain following radiation doses of more than 3,000 R, and in the spinal cord after 5,000 R. In the groups that were observed within 1 week, changes of the neuron were typical of acute swelling. In the group within 1 year, there were isochemic or atrophic changes. Vascular degeneration resulted in capillary hemorrhage, occlusion of small vessel, and edema of perivascular space, and

scar tissue was observed in survivors 1 year following irradiation at 15,000 R. Changes of the neuron were attributed to the indirect effect from disturbance of blood circulation or hypooxygenic conditions besides the direct effect. Secondary radionecrosis and glosis were found in the partial head irradiated group exposed to doses of 10,000 R. (NSA of Japan)

45794 SUCCINOXIDASE ACTIVITY OF THE RAT HEART AFTER WHOLE-BODY GAMMA IRRADIATION. Easley, J. F.; Shirley, R. L.; Davis, G. K. Quart. J., Fla. Acad. Sci., 28: 285-8(1965).

Rats were exposed to 1000 R of whole-body ^{60}Co gamma radiation at the rate of 40 R per minute and succinoxidase activity determined in the ventricle of the heart when the rats were sacrificed at 0.5 and 36-hour intervals after irradiation. Succinoxidase activity increased in the heart ventricle by 18% during the 36-hour postirradiation period when expressed on the basis of oxygen uptake per milligram of nitrogen. The increase was 19% when expressed on the basis of activity per gram wet weight, and 12% on the basis of whole heart after the heart weights were adjusted to the average weight of hearts within the various treatment groups. (auth)

45795 INTERACTION OF BLOOD SERA WITH PARAMECIUM CAUDATUM CULTURES. III. COMPLETE CONSUMPTION BY PARAMAECIUM CAUDATUM CULTURE IN NORMAL FRESH SERA OF IRRADIATED AND NON-IRRADIATED RATS. Cabadaj, Stanislav, Praslicka, Milan; Bernasovsky, Ivan (Safarik Univ., Kosice, Czechoslovakia). Biologia (Bratislava), 22: No. 1, 3-9(1967). (In Czech).

The number of minimum hemolytic doses (NHMD) of complement consumed by Paramecium caudatum from the blood sera of control and x-irradiated rats was determined. Values for NHMD varied in nonirradiated rats; however, a dose of 400 to 600 R resulted in a marked decline in NHMD after four days. When a dose of 200 R was administered, the decrease in NHMD was observed only on the fourth and sixth days. The level of complement did not change as a result of irradiation at a dose of 200 R. Irradiation at a dose of 400 R provoked an increase in the complement level that lasted 48 hours; the increase was followed by a further rise in the complement level. (TSS) (JPRS)

45796 RADIOBIOLOGICAL PROBLEMS OF IRON EXCHANGE OF THE ORGANISM. Adam, Geza; Miltenyi, Laszlo (Univ., Debrecen, Hungary). Strahlentherapie, Sonderbaende, 64: 151-4(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

After irradiation, a modification occurs in the Fe exchange of the organism. Whereas the introduction into the bone marrow and blood reduced for all the Fe products studied there was a successive increase in the liver of $FeCl_3$ and liver ferritine. The Fe uptake occurring in the bone marrow is reduced first. The ferritine extracted from the liver after irradiation showed the greatest accumulation. (tr-auth)

45797 HISTOCHEMICAL AND ULTRASTRUCTURAL MODIFICATIONS IN GUINEA PIG BRAIN AFTER THE EFFECT OF DIFFERENT TYPES OF RADIATION. Franke, Herbert D.; Lierse, Werner (Univ., Hamburg). Strahlentherapie, Sonderbaende, 64: 179-84(1967). (In German).

From 47th German Roentgen Congress, Berlin, May 18–21, 1966. See CONF-660566.

The brains of guinea pigs were homogeneously irradiated with 500 R, 1000 R and 3000 R (x-rays of 200 kV, γ-rays of ^{60}Co, electrons of 17 MeV). After killing the animals 24 hr later, ultramicroscopical and histochemical studies were made to compare the reactions of these three types of radiation. Changes in the permeability of the blood-brain barrier and edema of the astrocytes and the neurons after 500 R were observed. There was not much difference between these three types of radiation. Using PAS and astrablue, glycogen and muco-polysaccharides were formed in the glial cells and the neurons. The distribution of the positive cells varied in the different regions of the brain and depended especially on the type of radiation and the dose. After irradiation with electrons (17 MeV) the histochemical reaction was localized in the white matter; after conventional x-rays and ^{60}Co γ-rays it was localized more in the grey matter. This effect seemed to be independent of the degree of capillarization. (auth)

45798 EFFECT OF CONTINUOUS LOW-LEVEL GAMMA RADIATION ON ALLOXAN-INDUCED LETHALITY IN MICE. Watson, Joseph A.; Doolittle, Donald P. (Univ. of Pittsburgh). Radiat. Res., 32: 176-82(Sept. 1967).

The effect of a prior exposure of mice from conception until weaning to continuous low-level γ-radiation on the incidence of acute mortality from the subsequent injection of the diabetogenic compound alloxan was tested. No difference between irradiated and unirradiated animals was found either in gross mortality or in time distribution of mortality to 30 days after alloxan treatment under the conditions of these experiments. This suggested that radiation does not produce a nonspecific lowering of vitality in irradiated animals and that synergism between radiation and other stressing agents depends on some identity in the paths of effect. (auth)

45799 EFFECTS OF SMALL AND LARGE FIRST X-RAY DOSES ON THE TWO-DOSE RECOVERY PATTERN IN HeLa S-3 CELLS IN VITRO. Berry, Roger J. (Churchill Hospital, Oxford). Radiat. Res., 32: 13-20(Sept. 1967).

The shape of the two-dose-recovery curve for cells of a HeLa S-3 subline is dependent on the size of the first x-ray dose. After large first doses (800 to 1000 rads), the trough in the curve is absent when intervals of up to 10 hours elapse between x-ray doses. This appears to be due to an increase in the radioresistance of the cell population, shown by a shallower dose-response curve for survivors of a first x-ray dose of 800 rads which are challenged six hours later with second doses of 100 to 600 rads. Differences in the patterns of recovery in HeLa cells and those reported for Chinese hamster cells are ascribed to differences in the degree of postirradiation synchrony induced by the first x-ray dose. (auth)

45800 PARTIAL SHIELDING OF DOGS: EFFECTIVENESS OF SMALL EXTERNAL EPICONDYLAR LEAD CUFFS AGAINST LETHAL X-RADIATION. Cole, Leonard J.; Haire, Henry M.; Alpen, Edward L. (Naval Radiological Defense Lab., San Francisco). Radiat. Res., 32: 54-63(Sept. 1967).

Dogs were exposed to 250 kVp x-radiation while bearing a small external lead shield around the limb epicondyle. Such shielding permitted survival after otherwise lethal doses up to 1000 R. The protection was characterized by a critical recovery in the peripheral leukocyte counts usually observable by 12 days postirradiation. A single lead cuff was also effective against a 600 R dose of 1-mVp x-rays but not after 800 R. However, protection against mortality was evident at this radiation dose when double or triple layers of lead shield were employed. The theoretical basis for the findings is discussed in terms of critical functional repopulation of peripheral hemopoietic and lymphoid tissue sites via cellular seeding from the shielded marrow. (auth)

45801 LATENT EFFECTS OF PREFERTILIZATION X-IRRADIATION ON THE REPRODUCTIVE PERFORMANCE OF THE FEMALE RAT. Ward, William F.; Hahn, Eric W. (Univ. of Rochester, N. Y.). Contract W-7401-eng-49. Radiat. Res., 32: 125-30(Sept. 1967).

The data indicate that the reproductive response of the female rat irradiated at various times prior to mating is a function of; The irradiation dose, 250 r of whole-body x-irradiation induces significant increases in ovulations and implantations in females breeding four and eight d postexposure and in fetuses in females breeding four d postexposure, 500 r induces superovulation for a period of 16 d, superimplantation for 12 d, and significantly elevates average litter size in four d breeders; The time interval between irradiation and mating, under the conditions of this experiment, the initial effect of x-irradiation on reproduction is stimulatory. This effect is transitory, however, and reproductive performance returns to control levels. A significant decrease in the average number of living fetuses occurs in females breeding 16 and 20 d after 500 r. This effect is also transitory, with litter size returning to control levels in females breeding 24 d or more after irradiation. The results obtained in this experiment are compared with those of similar experiments in the mouse. (auth)

45802 IONIZATION IN THIN TISSUE-LIKE GAS LAYERS BY MONOENERGETIC PROTONS. Glass, W. A.; Samsky, D. N. (Battelle Memorial Inst., Richland, Wash.). Contract AT(45-1)-1830. Radiat. Res., 32: 138-48(Sept. 1967). (BNWL-SA-976).

Ionization resulting from the passage of monoenergetic protons through thin layers of tissue-like gas was measured. Samples equivalent to 0.3, 0.5, and 1.0 micron of unit-density absorber were investigated for incident proton energies ranging from a few KeV to about two MeV. Results are presented showing the mean rate of ionization as a function of incident proton energy for each of the three sample thicknesses. Typical results for the distribution of the measured values of ionization are also compared with values predicted by the Vavilov theory for energy loss distributions. (auth)

45803 ELECTRON MICROSCOPIC CYTOCHEMISTRY OF ^{131}I IRRADIATED THYROID GLAND. Sobel, Harold J. (Beth Israel Hospital, Passaic, N. J. New York Medical Coll.). Arch. Pathol., 84: 178-93(Aug. 1967).

The effect of ^{131}I irradiation of rat thyroid was studied electron cytochemically on tissue previously stained with enzyme

visualization techniques for plasma membranes, lysosomes, Golgi apparatus, endoplasmic reticulum, and periacinar vascular channels. Tissue ultrastructure and localization of enzyme activity generally correlated well with that noted in previous cytochemical and electron microscopic studies. Discrepancies in the interpretation of apical plasma membrane ATPase activity, and diffuse cytoplasmic staining with acid phosphatase preparations illustrated the difficulties encountered in comparing cytochemical and electron microscopic material. A serious problem in ultrastructural studies is the omission caused by the small size of the sample. The precision and value of cytochemical observations and the need for electron microscopic cytochemistry to be coupled with cytochemical and ultrastructural observations to minimize the inherent weaknesses of each technique are illustrated. (auth)

45804 FRACTURES OF FEMORAL NECK AND OF PELVIS AS A RESULT OF X-RAY TREATMENT OF CARCINOMA OF UTERUS. Taton, Jadwiga; Lukawska, Krystyna (Inst. of Oncology, Warsaw). Nowotwory, 17: 159-67(Apr.-June 1967). (In Polish).

Post-irradiation fractures of the femoral neck and of the pelvic bones were observed in 50 out of 4426 patients treated with X rays and radium gamma rays because of genital carcinoma. The frequency of osseous complications increased with the age of treated patients. The symptoms of post-irradiation fractures occurred in the period from 2 months to 11 years after the completion of treatment. The clinical and radiological pictures of post-irradiation fractures are described in detail as well as the methods of preventive actions and of early diagnosis of bone injuries occurring as the result of radiologic treatment. (auth)

45805 REMARKS ON A CASE FILE OF BILATERAL MAMMILARY CANCERS. Bergonzi, L.; Ferolla, C.; Morin, M. (Univ. Modena, Italy). Minerva Radiol., Fisioterap. Radiobiol., 12: 149-58(1967).

Forty four patients suffering from bilateral carcinoma of the mamilla and treated in the Radiology Department between 1950 and 1963 are discussed. The problems relative to the pathogenesis of the double localization are examined on the basis of personal experience and the data contained in the literature. The line of conduct followed in radiant therapy is examined and the physico-biological problems above all in relation to tolerance are discussed. The immediate and long-term results show a survival rate of 65% at three years and 2% at five years. The usefulness of radiotherapy is confirmed even though it is difficult to perform. (auth)

45806 SCIALOGRAPHIC PICTURE OF THE IRRADIATED PAROTID. Baroncelli, G.; Viviani, G. (Spedali Civili, Brescia, Italy). Radiol. Med., 53: 546-62(June 1967). (In Italian).

After describing the anatomical modifications produced by the irradiation in the normal parotid, the results of the scialographic study of 70 patients who were irradiated on the parotid during radiotherapy for tumors of the head and of the neck are reported. In the irradiated parotid it was possible to distinguish the following: an early scialographic picture that was principally characterized by the presence of a scialo-acinar reflux and by the impregnation of the parenchyma and a late scialographic picture characterized by alterations of number, caliber, and course of the ducts. These scialographic alterations (that were much more evident according to the irradiated glandular volume and to the absorbed dose) were present for about ⅔ of the cases. Together with these alterations there were modifications of the serum rate of the diastase: the values of the diastasemy increased during the first hours after the irradiation, attained the maximum towards the third day and then decreased progressively towards normalization by the seventh day. (auth)

45807 A STUDY ON THE TRANSPLANTATION TO RAT'S FEMUR OF EXPERIMENTAL SARCOMA IRRADIATED WITH A MASSIVE X-RAY DOSE. Nagatsuka, Hiroshi (Tokyo Medical and Dental Univ.). Ochanomizu Igaku Zasshi, 13: 35-43(Sept. 1965). (In Japanese).

The inactivation of tumor cells caused by x irradiation and the effect of the time interval between irradiation and transplantation on the inactivation were studied, using methylcholanthrene-^{32}P-sarcoma subcutaneously transplanted to the right thigh of rats. The growth rate of methylcholanthrene-^{32}P-sarcoma and its histological phenomena, after a single x irradiation (100 kV, 18 mA) of 4000 R, were observed for 4 weeks. The inhibitory effect of x radiation on the tumor growth continued for 3 weeks, and its effect was highest in the 3rd week after irradiation. The histological findings showed that the tumor cells began to proliferate in the 3rd week and the tumor grew again in the 4th week. A part of the methylcholanthrene-^{32}P-sarcoma was irradiated with a single dose of 3000 or 4000 R. This irradiated part was transplanted into the bone marrow of rat femur 1 hour, 2 days, or 7 days after irradiation. Transplantability was compared with that of the control in which non-irradiated parts are transplanted. A reduction of transplantability was observed in the group transplanted on the 7th day after irradiation with a dose of 3000 or 4000 R. In the group transplanted earlier after irradiation, no reduction of transplantability was found. There was no difference in the x-ray findings of femur and histological findings of tumor between the irradiated and the non-irradiated tumors. The irradiated tumor grew similarly to the non-irradiated ones. (NSA of Japan) (TSS)

45808 EYE ABNORMALITIES IN MICE EMBRYOS CAUSED BY X IRRADIATION OF THE MOTHERS. (2nd REPORT). Majima, A.; Sakurai, T. (Nagoya Univ., Japan). Nippon Ganka Kiyo, 12: 166-71(1961). (In Japanese).

Mice were given a single whole-body x-radiation dose of 150 R on the eight day of pregnancy. The embryos were examined macro- and microscopically on the 16th fetal day and findings were compared with those in previous experiments on embryos examined on the 13th embryonic day. In macroscopic examinations, 59.3% embryos had gross abnormalities which was about the same rate as in the group examined on the 13th day. The percentage of dead embryos was less than in those examined on the 13th day probably due to the maceration of embryos with severe malformations. Macroscopic eye abnormalities were found in 28.5% of the total examined, which was almost equal with that in the 13-day embryos. Eye abnormalities consisted chiefly of microphthalmia, found on the right side more than on the left. Some changes were observable microscopically after the 13th embryonic day, such as infolding and eversion of the inner wall on the margin of the choroid fissure, and a cystic cavity formed by the duplicated inner and outer walls. Such anomalies were considered as phenocopies of hereditary uvea coloboma. Embryos with aphakia were often found. Presumably the lenses that might have been induced in earlier stages degenerated under the abnormal conditions, such as abnormal direction of the axis of the optic cup and maldevelopment of the optic cup, resulting in apparent or secondary aphakia. Pseudoencephalic embryos showed remnants of complicated infolded optic cups without lenses. Such optic cups with a vertical axis were formed directly under the brain. (BBB)

45809 IRRADIATED LARVAL VACCINES. Urquhart, G. M.; Jarrett, W. F. H.; Mulligan, W. (Univ. of Glasgow). Advan. Vet. Sci., 7: 87-129(1962).

This review includes a discussion of the use of ionizing radiation to produced helminth vaccines. The main practical considerations involved the technique of irradiation, quality of radiation used, total dose of radiation necessary to produce the desired partial inactivation or attenuation, rate of delivery of the radiation dose, number of infective larvae given per vaccine dose, and timing of repeat or booster doses. The experiments on various parasites have had a similar general design; those on Dictyocaulus viviparus are given in detail as an example. Calves received a single dose of 4000 larvae which had been treated with 20, 40, and 60 Kr, after pilot experiments had shown that the optimal dose of x-radiation is within this range. Fifty days after vaccination the calves were challenged with 4000 normal larvae. The control calves had over 1000 worms, and their lungs were markedly consolidated. Calves receiving larvae treated with 20 and 40 Kr showed reduced take of around 15 worms, indicating a high degree of immunity. Results showed that fewer larvae reach the lungs if they have been x-irradiated, and those that do disappear by the end of the second week after infection. Histologic examination of the lungs showed distinctly fewer lesions in animals receiving irradiated larvae. Techniques of irradiation are described in detail. (BBB)

45810 CHANGES IN RADIOSENSITIVITY OF MICE AFTER SEVERAL DAYS OF HYPOXIA. INVESTIGATIONS ON SPLENECTOMIZED ANIMALS. Tribukait, Bernhard (Karolinska Inst., Stockholm). Strahlentherapie, 133: 631-6(Aug. 1967). (In German).

In order to further investigate the changes in radiation sensitivity following a period of exposure to hypoxia, splenectomized mice were kept under hypoxia corresponding to 6000 m altitude over a period of 10 days. As already observed in non-splenectomized animals, the radiation sensitivity was decreased 24 to 72 hours after transfer to normal oxygen pressure. While non-splenectomized animals showed an increased radiation sensitivity 6 hours after the period of hypoxia, splenectomized animals showed, at a dose of 950 to 1000 R, a lower radiation sensitivity. No reduction in radiosensitivity was observed, however, 6 hours after the period of hypoxia, at 1050 R. Splenectomized mice, irradiated after the period of hypoxia, showed the same characteristic behavior of the body weight as non-splenectomized animals. Therefore, the spleen does not seem essentially to influence the changes in radiation sensitivity following a period of exposure to hypoxia. (auth)

45811 RADIATION INJURIES TO MOUSE EMBRYOS IN EARLY PREGNANCY. **Trautmann, Johannes; Kollath, Juergen; Munscheck, Heinz (Staedt. Krankenhauses Moabit, Berlin). Strahlentherapie, 133: 585-93(Aug. 1967). (In German).**

The literature concerning radiation induced damages to the fetus is based in only a few cases upon experimental investigations. 1500 fetuses received a single acute irradiation of 200 R at the beginning of the preimplantation period. An increase in the resorption rate, a decrease in litter size and of the average weights was observed. Pathological changes could not be observed after irradiation with 100 R. Irradiation with sublethal doses (25 R, 50 R, 100 R, and 200 R) sometimes resulted in brain defects, the same kind of which was also seen after 10 years of experiments with an inbred strain. Investigation of fetal damage after irradiation with 100 R and smaller doses should be done microscopically as well as submicroscopically. (auth)

45812 OVARIAN CHANGES INDUCED BY CHRONIC GAMMA RADIATION EMITTED BY SEALED ^{60}Co SOURCE PLACED INSIDE THE ABDOMEN IN THE INDIAN DESERT GERBIL. **Rao, A. Ramesha; Srivastava, P. N. (Univ. of Rajasthan, Jaipur, India). Strahlentherapie, 133: 594-601(Aug. 1967).**

When sealed source of gamma radiation (30 μCi of ^{60}Co in polyethylene capsule) is placed inside the abdomen of young adult female Indian desert gerbil, Meriones hurrianae Jerdon, ovaries are subjected to continuous irradiation. The ovaries undergo atrophy; there is progressive loss of follicular apparatuses and involution of ovarian cortex. The maturing and primordial follicles sustain considerable damage whereas the insult imposed upon the medium-sized follicles is comparatively less. There is no "effective" histological sterilization even after one month of continuous irradiation. Ovarian stroma shows condensation, fibrosis and fatty degeneration. Uterine horns show atrophy. (auth)

45813 CHANGES IN RAT HEARTS AFTER FOCAL DOSES OF X RADIATION. **Morgenroth, Konrad Jr.; Junge-Huelsing, Gerhard; Hauss, Werner H. (Univ., Muenster, Ger.). Strahlentherapie, 133: 610-20(Aug. 1967). (In German).**

Electron microscopic studies were done on hearts of rats after x irradiation with a focal dose of about 3,000 R. Investigations done at different time intervals showed significant changes in the capillaries of the heart muscle. The formation of shoots and loops as well as swelling of the capillary endothelium results in a constriction of the width of the vessels. In the heart muscle cells, vacuoles in the mitochondrias and a dilatation of the sarcoplasma reticulum are found in later stages after irradiation. Big spaces are formed in the cells which are free of formed substances and show only a granular content. It is not clear whether those changes are the result of a direct radiation influence upon the heart muscle cells or caused secondarily by damage to the capillaries. Since the capillary damage with the swelling of the endothelium occurs prior to the changes in the heart muscle cells, it is assumed that this damage of the capillary endothelium causes primarily a disturbance in permeability and nutrition which is followed by necroses of the heart muscle cells. (auth)

45814 ROLE OF CAPILLARIES IN THE PATHOGENESIS OF DELAYED RADIONECROSIS OF BRAIN. **McDonald, Larry W.; Hayes, Thomas L. (Univ. of California, Berkeley). Amer. J. Pathol., 50: 745-64(May 1967).**

Increase in capillary basal lamina thickness is regularly seen from 1 to 3 months following proton or alpha-particle irradiation of the rabbit brain. This thickening is present in areas adjacent to radionecrotic tissue. Radiation changes that appear in areas not related to necrotic tissue include endothelial- and perivascular-cell edema. The number and size of cytoplasmic vacuoles and inclusions is increased. Splitting of capillary basal lamina is present, but thickening of basal lamina is not so marked as in areas adjacent to necrotic tissue. The scanning electron microscope and a large-block recovery method for transmission electron microscopy were used to show that the capillary changes are limited to the irradiated area and that capillary basal lamina thickening is found primarily in areas adjacent to necrotic tissue. (auth)

45815 CONTROL OF FRUIT FLIES DACUS ZONATUS SAUNDERS BY GAMMA RAYS. **Huque, H.; Malik, Q. R. (Radioisotope and Radiation Lab., Karachi, Pakistan). Int. J. Appl. Radiat. Isotop., 18: 658-61(Sept. 1967).**

The damage and loss caused by this insect to fruits and vegetables is very severe in Karachi. Investigations are described which were carried out to explore the possibilities of control by sterilizing males in pupal stages with gamma rays and then releasing them to mate with the wild females. It was concluded that the minimum dose required to render the males incapable of fertilizing females is 7 to 9 kR when radiation is applied in late pupal stage. Non-irradiated females when mated with irradiated males produced eggs which were not viable. It is considered that the technique shows great promise for the elimination of this severe pest. (UK)

45816 EFFECT OF PREVIOUS X-IRRADIATION ON THE RESPONSE OF BRAIN TO INJURY. **Hopwell, J. W.; Wright, E. A. (St. Mary's Hospital, London). Nature (London), 215: 1405-6 (Sept. 23, 1967).**

It was found that the normal adult mammalian central nervous system shows no early or late morphological effects after a single dose of x irradiation up to 1000 R, and even with doses of 2,000 to 4,000 R there is a delay of many months before damage appears. The present authors, however, showed that the cerebral glial reaction to injury is diminished after doses as small as 200 R, and appears to be independent of time between irradiation and injury. Experiments with rats, in this connection, are described. Brains of 3 to 4 months old animals were irradiated with single x ray doses of 200 to 4,000 R, at 90 to 95 R/min. At intervals of between 3 days and 6 months after irradiation a small superficial area of the brain was injured by freezing through the calvarium. The normal response to this freezing injury was necrosis, followed by cell division and infiltration commencing at the periphery of the lesion. Sections of each lesion were cell counted. Results for animals irradiated 3 days before injury are shown graphically, and some results are given for longer periods. A simple explanation is that glial cells may not show radiation damage until they are stimulated to divide, at which time they either fail to divide or die. This "storing-up" of damage is possibly due to the slow turnover of glial cells in normal conditions, so that replacement does not occur to any extent. The hypothesis that previously irradiated local glial cells die on attempting division is dependent on the assumption that most of the cells originate endogenously. (UK)

45817 SUPPRESSION OF NATURAL HAEMOLYSIN TITRE IN RABBITS EXPOSED DAILY TO GAMMA RADIATION. **Draper, L. R. (National Cancer Inst., Bethesda, Md.). Nature (London), 215: 848-9(Aug. 19, 1967).**

It has been found that acute whole-body x irradiation of rabbits with 300 to 700 R depresses the synthesis of natural anti-sheep hemolysin. This serum antibody, which occurs normally, is thought to arise in response to small amounts of related Forssman antigens entering the rabbits environment. Recovery commences about 2 weeks after irradiation, and normal or enhanced titres are usually reached within a few weeks. A second irradiation provokes a second sequence of depression and recovery. This resilience prompted a study of the extent to which hemolysin production could withstand injury sustained during protracted irradiation with small daily exposures. Some of the rabbits received an injection of sheep red cells 1 year previous to irradiation. Based on LiF dosimetry the daily midline air exposure to ^{60}Co gamma radiation averaged 25 R at about 12 R/min. Although hemolysin titre usually declined with increasing total exposure, it fell more slowly in previously immunized rabbits. A few rabbits which had survived an exposure of 7,400 R were injected intravenously with sheep red cells to test their ability to respond to specific challenge. Results were consistent with those of previous studies involving protracted irradiation and specific immunization. The relative radiation resistance of hemolysin production among rabbits previously immunized may reflect either an expanded compartment of immunocompetent cells or, through immunological memory, a great susceptibility to Forssman stimulus. (UK)

45818 PROBLEMS OF IRRADIATION INVESTIGATIONS DURING HYPOTHERMIA AND HIBERNATION. **Reinhardt, Kurt (Roentgenabteilung des Kreiskrankenhauses, Voelklingen/Saar, Ger.). Strahlentherapie, 133: 396-405(July 1967). (In German).**

Reports in the literature indicate that natural hibernation has a different influence upon the radiation effect than artificial hypothermia. In some amphibians (Urodelen) the temperature decrease showed an influence upon the radiation effect only when done during x irradiation; in other amphibians (Anures) only when done after irradiation. Different development stages of some species show a controversial behavior regarding the time of hypothermia application. Moreover, the temperature effect can be reversed depending on whether the hypothermia is performed under aerobic or anaerobic conditions. (auth)

45819 LEUKOPENIA FREQUENCY IN X AND TELECOBALT THERAPY. **Neumeister, Klaus (Karl-Marx-Univ., Leipzig). Strahlentherapie, 133: 349-53(July 1967). (In German).**

A radiation induced leukopenia can cause a discontinuation of radiotherapy. Special attention was given to factors which influence the incidence of leukopenia. Evaluation of hematological changes during x and γ therapy in patients with carcinoma of the cervix, using different physical-technical radiation conditions

as models, showed a difference in the frequency of leukopenia. The influence of integral dose, bone marrow dose, and radiation quality is discussed and conclusions are drawn for clinical radiation biology. (auth)

45820 INFLUENCE OF GESTATION AND LACTATION ON RADIOSTRONTIUM-INDUCED MALIGNANCIES IN MICE. II. RETENTION OF RADIOSTRONTIUM AND RELATION BETWEEN TUMOUR INCIDENCE AND EXCRETION RATE. Nilsson, A.; Nelson, A.; Ronnback, C.; Sjoden, A.-M.; Walinder, G.; Hertzberg, O. (Research Inst. of National Defence, Sundbyberg, Sweden). Acta Radiol., Ther., Phys., Biol., 6: 129-44(Apr. 1967).

It was shown in an earlier paper that gestation and lactation influence induction of tumor by ^{90}Sr in mice. The latency period extended and the bone tumor rate decreased in a mated group giving suck in comparison with an unmated group. In the work now reported the excretion rates of ^{85}Sr in groups of unmated mice, only-mated mice, and mated mice giving suck were investigated. The influence of gestation alone was negligible; lactation, however, significantly decreased the retention. A relation between tumor rate and excretion rate in the individual bones was obvious. The parameters of the radiation doses influencing the production of ^{90}Sr-induced bone tumors are discussed. (auth)

45821 LONG SURVIVAL IN LUNG CANCER FOLLOWING RADIATION THERAPY AND PNEUMONECTOMY, RESPECTIVELY. ANGIOGRAPHIC AND PATHOLOGIC STUDIES. Steinberg, Israel (New York Hospital–Cornell Medical Center, N. Y.). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 100: 620-5(July 1967).

Two men, aged 59 and 65 years, lived 17 and 9 years after radiation therapy and pneumonectomy, respectively, for cancer of the lung. The first patient had spontaneous fractures of ribs, radiation dermatitis, and skin ulcerations along the portals of treatment. The right lung became fibrotic. An angiocardiogram made 6 years after radiation therapy showed occlusion of the right pulmonary artery. He died 17 years after radiation therapy of thromboembolism of the left pulmonary artery and branches following a series of skin graftings made to repair the radiation damage of the skin. The other patient died of pulmonary edema, pulmonary emphysema, and corpulmonale. An angiocardiogram, made 7 years after left pneumonectomy and 2 years before death, showed over-distention of the right lung due to pulmonary emphysema. Both patients showed no recurrence of the cancer at autopsy. (auth)

45822 COMPARATIVE GENETIC EFFECTS OF LOCAL AND WHOLE-BODY IRRADIATIONS IN THE MALE MOUSE. Leonard, A.; Deknudt, G. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Compt. Rend. Soc. Biol., 160: 2492-4(1966). (In French).

Male mice of the race BALB/C were exposed to whole-body irradiation or local irradiation on the testicles at a dose of 400 R x rays. After treatment, each male was bred with three virgin females who were replaced by other virgin females after 7 and 14 days. These females were dissected 10 days after being separated from the male. The dissections showed that the dominant lethality rate depended principally on the x-ray dose received by the reproductive cells. The irradiation dose received by the rest of the body had no statistically valid effect. (tr-auth)

45823 COMPARATIVE INVESTIGATIONS OF RADIATION EFFECTS ON RABBIT LENSES. Schaefer, Peter; Krokowski, Ernst; Schumacher, Werner; Frost, Dietrich (Freie Univ., Berlin). Strahlentherapie, 133: 367-70(July 1967). (In German).

A linear dose dependency of somatic radiation damage was observed in growing rabbit lenses after irradiation with 60 KV x rays. This result was used as a basis for a series of comparative investigations with 35 MeV-electrons. For this radiation quality, an almost quadratic dose-effect-relation was observed in rabbit lenses which were irradiated at an age of 20 days and observed during a period of 6 months. Furthermore, a comparison of the dose effect curves of both irradiation series revealed a dose dependent RBE-factor for the experimental conditions used. The influence of different physical and biological factors upon the dose-effect-relation is pointed out. (auth)

45824 FERTILITY OF FEMALE MICE AFTER FRACTIONATED IRRADIATION DURING INFANCY. Langendorff, Hans; Langendorff, Margarethe (Univ., Freiburg i. B. Heiligenberg-Institut, Ger.). Strahlentherapie, 133: 371-89(July 1967). (In German).

Female mice were x irradiated daily with 1.25, 2.5, or 5R one to twenty days after birth and the fertility of the irradiated animals was determined from the beginning of sex maturity to the end of the reproductive period. Irradiation of the mice with 20 × 2.5 R/day was less effective than irradiating the animals 10 times with 5 R/day; irradiations were done with different time intervals within the 20 day period. Fertility was higher in female mice which were irradiated between the 1st and 5th day and between the 16th and 20th day after birth than in those which were irradiated between the 6th and 15th day. The lowest fertility was found to occur in animals which were irradiated with 5 × 5 R/day between the 6th and 10th day of life. Serotonin, which was administered to 11 to 15 day old animals prior to each irradiation with 5 R/day, showed only a slight influence upon the fertility of the irradiated animals. (auth)

45825 HISTOLOGY AND CYTOLOGY OF IRRADIATED THYMUS. PART IV. THE EFFECTS OF PARTIAL-BODY IRRADIATION. Braun, Hildegard (Univ., Freiburg i. B.). Strahlentherapie, 133: 411-21(July 1967). (In German).

The effects of partial-body exposure to x radiation upon the thymus weight in mice and alterations of cell population of the organs were studied. Following irradiation of head and thorax with 800, 400, and 200 R organ weight decrease was similar to that following a corresponding dose of whole-body radiation. The greatest part of the weight loss was caused by cell migration. 6 hours after 800 R about 50% of all lymphocytes are pyknotic. Irradiation of the head with 1200, 800, 400, and 200 R influenced neither weight of the thymus nor number of pyknotic cells. Irradiation of the abdomen with 800, 400, and 200 R resulted in essentially the same findings as after irradiation of the head. Independent from the appearance of pyknotic cells, the number of reticular cells increased immediately after irradiation. Extensive formation of vesicles with involvement of the Golgi area, endoplasmatic reticulum, and mitochondria could be observed under the electron microscope. Contrary to whole-body irradiation, partial-body exposure resulted in normal phagocytic activity of the reticulum cells. (auth)

45826 INVESTIGATIONS ON THE INFLUENCE OF A 50-RAD WHOLE-BODY IRRADIATION OF VARIABLE RADIATION QUALITY ON THE PERIPHERAL BLOOD PICTURE OF GUINEA PIGS. zur Horst-Meyer, Horst; Degner, Wolfgang (Humboldt Univ., Berlin). Strahlentherapie, 133: 422-5(July 1967). (In German).

Intensive depression of the granulocytes occurring after whole-body γ irradiation with 50 rad in guinea pigs did not depend, unlike the lymphocytes, upon the radiation quality used. The granulocyte level in the peripheral blood after whole body irradiation with 50 rad returned to normal only after the intramedullar reserve had been filled up. In an emergency (infection), however, the granulocyte level in the peripheral blood increased by injection from the intramedullar reserve. (auth)

45827 FRACTIONATION IN CLINICAL RADIOTHERAPY. Baclesse, F. (Hopital Americain, Neuilly, France). pp 493-512 of Radiobiologie Appliquee. Tome II. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

The clinical reactions to fractionation of radiotherapy are reviewed. Protraction and the cutaneous-mucous reactions during the Coutard epithelial method are considered. The vaccination is discussed with respect to the cutaneous reactions observed during long fractionations and survival after long fractionation treatments. The economic and biological factors in fractionation are discussed. (J.S.R.)

45828 RADIOIMMUNOLOGY. Mathe, G (Institut Gustave-Roussy, Villejuif, Franch). pp 419-89 of Radiobiologie Appliquee. Tome I. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

The essential concepts on the status of immunity are first reviewed. The development of data on the effect of radiation on the states of immunity is summarized. The effect of radiation on antibodies and their formation is studied. The effect of radiation on the para-immunological defenses is considered. Practical applications of the radioimmunity reaction are discussed with respect to infection in irradiated patients and incompatible grafts after whole-body irradiation. 303 references. (J.S.R.)

45829 EFFECTS OF X RAYS ON THE EMBRYO AND FETUS OF MAMMALS. Raynaud, Albert (Institut Pasteur, Paris). pp 513-81 of Radiobiologie Appliquee. Tome II. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

The effects of x rays on the embryo of mammals, produced by the general irradiation of the embryo, were described on the basis of relatively recent experimental results. Results obtained with ionizing radiation other than x rays are only mentioned. After a description of the techniques used, the effects produced by irradiation at different gestation stages on the viability of the embryo, its growth, and its organogenesis were described, using the embryos of rats and mice as examples. This description is followed by a discussion in which the experimental results are interpreted

as a function of the stage of development of the embryo at the moment of irradiation and of the dose administered. The effects on the embryonic development of the rat and mouse of the irradiation of the gonads of the parents and of the irradiation of gametes are briefly considered. The human implication of these experimental studies is discussed in relation to the following: similarity of the malformations observed in the rodent fetuses and human fetuses accidently exposed; prediction of the effects of radiation as a function of the embryonic stage of development; precautions to be taken during the radiologic examination of the pelvic region in the female. 118 references. (tr-auth)

45830 CANCEROGENIC EFFECTS OF IONIZING RADIATIONS. Lacassagne, A.; Gricouroff, G (Institut du Radium, Paris). pp 583-646 of Radiobiologie Appliquee. Tome II. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

X and γ radiation and corpuscular radiation can induce cancers in any tissue or organ. The nature of the inducing radiation, the experimental or clinical conditions, and the modalities of the irradiation are described for cancers of the skin, lung, digestive tract, liver, kidney, thyroid, pituitary, ovary, uterus, and mammary gland. Radiosarcomas of the deep-lying tissues are also discussed. Radiocancers following a whole-body irradiation of the exterior of the body are considered. 221 references. (J.S.R.)

45831 RADIOLEUKOSES. Rudali, G (Fondation Curie, Paris). pp 647-67 of Radiobiologie Appliquee. Tome II. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

The leukoses considered include not only the classic leukemias but all the malign proliferations of one of the cellular varieties of the reticulo-hemopoietic system. No distinction is made as to the type of radiation causing the leukoses. Human radioleukemias are first discussed. The radioleukoses found in the different animal species are described. Radioleukemias in the mouse are then discussed with respect to the technical conditions of leukemization, effect of heredity, hormonal influence, the effect of age, and the co-leukemogenic factor. The role of virus conception of radioleukemias, cellular conception of radioleukoses, and the role of target organs in leukemogenesis are discussed in the formulation of a possible mechanism of radioleukemogenesis. 111 references. (J.S.R.)

45832 BIOLOGICAL EFFECTS OF THE TRANSMUTATION OF INCORPORATED RADIOISOTOPES. Moustacchi, E. (CNRS, Paris). pp 807-37 of Radiobiologie Appliquee. Tome II. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

The principle of the method of studying the biological effects of the decay of the radioisotopes ^{3}H, ^{14}C, ^{32}P, ^{33}P, and ^{35}S is outlined with a discussion of the specific activity, half-life, cellular location of the radioisotope, and the relation of Hershey with a definition of the efficacity coefficient. The lethal and mutagenic effects of incorporated radioisotopes are reviewed. The effects of the decay of ^{32}P on the recombination of genetic material are shown. The phenotypic effect of the decay of incorporated radioisotopes is considered. In the proposal of a mechanism of the cellular effects of radioisotopes, the relative importance of the transmutation and of the emission of ionizing radiation is discussed. The cellular effects of the transmutation are interpreted for the case of ^{32}P and ^{14}C. (J.S.R.)

45833 NUCLEAR RADIOLESIONS CAUSED BY THE USE OF RADIOACTIVE PRECURSORS OF NUCLEIC ACIDS. Zajdela, F. pp 839-68 of Radiobiologie Appliquee. Tome II. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

Data are given on nuclear radiolesions following the incorporation of tritium-labeled thymidine by deoxyribonucleic acid. The radiolesions observed in animal and vegetable tissue are described and the radiolesions at the cellular level are discussed. The principal experimental factors in the production of radiolesions by intranuclear irradiation are summarized; the methods for dosimetry are given. The practical consequences of autoradiographic experiments are considered. (J.S.R.)

45834 THE RADIOBIOLOGY OF CULTURED MAMMALIAN CELLS. Elkind, Mortimer M.; Whitmore, Gordon F. New York, Gordon and Breach Science Publishers, 1967. 628p.

Data are reviewed on cell survival theory, mammalian in vivo and in vitro survival assay systems, the influence of chemical and physical factors on mammalian cell survival, cell recovery from radiation damage, effects of radiation on division and growth, radioinduced chromosome aberrations, and the biochemical effects of radiation. Eight separate abstracts were prepared covering these subjects. The appendix describes cell culture techniques. (M.M.B.)

For abstracts of individual chapters see: 45514, 45835–45840, and 50066.

45835 IN VITRO SURVIVAL CURVES. pp 53-115 of The Radiobiology of Cultured Mammalian Cells. Elkind, Mortimer M.; Whitmore, Gordon F. New York, Gordon and Breach Science Publishers, 1967.

The characteristics, advantages, and limitations of the colony formation criterion of mammalian cell survival are described. Various factors influence plating efficiency (P.E.) such as the presence of x-ray sterilized, metabolically active, feeder cells. The degree of survival independence, the influence of cell age, and the effects of ploidy on survival curves are discussed. Unlike yeast plants, and insects with polyploid chromosome sets, mammalian cells do not show a consistent relation between survival after irradiation and the ploidy. 85 references. (M.M.B.)

45836 SURVIVAL CURVE THEORY. pp 7-51 of The Radiobiology of Cultured Mammalian Cells. Elkind, Mortimer M.; Whitmore, Gordon F. New York, Gordon and Breach Science Publishers, 1967.

The effects of ionizing radiations on yeast and mammalian cell culture populations are discussed with respect to survival of proliferative integrity as an end point. The discussion is based on the discreteness and randomness of the energy absorption. A review of the theoretical and practical aspects of survival curve analysis is presented with mathematical models. Three formal models are discussed, i.e., exponential survival, multitarget single-hit survival, and single-target multihit survival. Factors that should be considered in interpretation of data are presented, namely: survival independence; homogeneity of the population; and biological responses in the context of hit-survival functions and damage repair. (M.M.B.)

45837 IN VIVO ASSAY SYSTEMS. pp 117-43 of The Radiobiology of Cultured Mammalian Cells. Elkind, Mortimer M.; Whitmore, Gordon F. New York, Gordon and Breach Science Publishers, 1967.

Methods of in vivo assay of cell survival are discussed. The assay systems described are those using isologous leukemia and sarcoma cells, heterologous ascites carcinoma cells, and normal isologous bone marrow cells. These may be irradiated in animals or media under various O_2 tensions. In each assay average number of surviving cells that must be injected per animal to ensure that 50% of the animals will exhibit the specific effect should be determined. Competent cells are those surviving cells that are capable of causing the specific endpoint. Various factors such as immunological responses, cell products, latent viruses, crowding, and local O_2 tension affect the results. In spite of these difficulties good quantitative results may be achieved with these assay systems. (M.M.B.)

45838 INFLUENCE OF CHEMICAL AND PHYSICAL FACTORS ON SURVIVAL. pp 145-235 of The Radiobiology of Cultured Mammalian Cells. Elkind, Mortimer M.; Whitmore, Gordon F. New York, Gordon and Breach Science Publishers, 1967.

Some of the chemical and physical factors that modify survival responses of mammalian cells to radiations are discussed. The view that mammalian cells are influenced by oxygen in much the same way as other cells is supported by the data, but it is felt that more data are needed. The enhancement of the radiation response of cells treated with halogenated pyrimidines is described, and the possible mechanisms for this effect are discussed in an effort to evaluate the DNA-lethality hypothesis. The effect of actinomycin D is also discussed. Survival after exposure to different kinds of radiations reveal that, in general, the effect of high compared with low LET radiations enhance killing. The evidence is consistent with the inactivation of different sites (or repair systems) with low as compared to high LET radiations. Modifying agents such as O_2, halogenated pyrimidine, and cysteamine are generally less effective in connection with high as compared to low LET radiations. The reasons for this are not clear. At present the LET-RBE data do not provide an answer to the biological identity problem of the sites of action of ionizing radiations. (M.M.B.)

45839 RECOVERY FROM RADIATION DAMAGE. pp 237-301 of The Radiobiology of Cultured Mammalian Cells. Elkind, Mortimer M.; Whitmore, Gordon F. New York, Gordon and Breach Science Publishers, 1967.

The repair of radiation damage to proliferative ability of mammalian cells is discussed. These cells can repair sublethal x-ray damage, but do not appear to repair sublethal ultraviolet radiation damage. This result and the observation that in mammalian cells ultraviolet-induced thymine dimers are not excised lead to the conclusion that different repair mechanisms are present in microorganisms and mammalian cells. Sublethal repair mechanisms may be studied by dose-fractionation or dose-rate variation experiments. Very few quantitative experiments of the latter type

are available for analysis. Before the effects of repair and progression (toward division) and cell division on net viability can be separated more must be known about the dependence of division on dose-rate. It was concluded from low LET two-dose fractionation studies that repair in surviving sublethally damaged cells is not dependent on temperature, happens within a few hours after radiation, is completed before onset of division, and is not a consequence of growth and division. Animal survival implications of stem-cell survival may be studied by fractionation experiments. The post irradiation survival kinetics of mouse spleen colony (nodule) forming cells are described. High LET fractionation studies in contrast to low lead to the conclusion that alpha irradiation does not result in sublethal damage to mammalian cells and may differ in its mechanism of action on these cells. 85 references. (M.M.B.)

45840 EFFECTS OF RADIATION ON DIVISION AND GROWTH. pp 303-82 of The Radiobiology of Cultured Mammalian Cells. Elkind, Mortimer M.; Whitmore, Gordon F. New York, Gordon and Breach Science Publishers, 1967.

The effects of radiation on reproduction of cultured mammalian cells are discussed. After irradiation the presence of mitotic cells and cell division is suppressed. The length of mitotic delay and division delay varies with radiation dose, cell type, and physiological condition of the cell at the time of irradiation. After the delay period the cells begin to divide, but only the survivors continue indefinitely and give rise to colonies. The non-survivors may give rise to abortive colonies, lyse, remain dormant, form giant cells, or undergo a combination of these processes. Experiments dealing with these processes and growth rates are described. Studies with Chinese hamster cells, L-cells, LP59, HeLa, human amnion, and Ehrlich ascites cells are discussed. The analysis of growth curves for these studies is described. Experiments with L-cells are reported in which agmatine appeared to protect against mitotic delay after x irradiation. 56 references. (M.M.B.)

45841 CYTOCHEMICAL INVESTIGATION OF THE EFFECT OF X RAYS ON THE CELL ACTIVITY IN THE RETICULO-ENDOTHELIAL SYSTEM. Dobrek, Zbigniew. Katowice, Poland, Warynski Silesian School of Medicine, 1964. (In Polish).

Thesis.

An attempt was made to explain certain processes occurring in the cells of the reticulo-endothelial system of an animal irradiated with a lethal dose of x-ray on the basis of the special role of this system in radiation disease. Experiments were conducted using A strain mice and Wistar strain rats. The animals were given one 750 R dose of x-rays. The experiments were designed to determine whether or not the increased number of phage cells showing an increased histochemical reaction to acid phosphatase in liver and spleen was accompanied by increased phagocyte activity of those elements. (JPRS)

Radiation Effects on Plants

Refer also to abstract 45833.

45842 CYTO-EMBRYOLOGICAL STUDY OF BEANS UNDER THE EFFECT OF X RADIATION. Semerdzhyan, S. P.; Saakyan, T. A.; Oganesyan, Dzh. O. (Erevan State Univ.). Biol. Zh. Arm., 20: No. 5, 12-22(May 1967). (In Armenian).

A cyto-embryological study was made of beans from hybrid plants obtained from irradiated and nonirradiated seeds. The irradiation dose was 500, 3000, and 5000 R. The results showed that during hybridization of beans fertilization occurred within 10 hrs after pollination in some seed pods. Within 24 hrs after irradiation in all variants, nuclear endosperm and two to four cell seeds were formed. Pollination of the flower of the plant from nonirradiated seeds with pollen from plants from irradiated seeds stimulated the formation of seeds and endosperm. Doses of 5000 R did not affect the normal process of fertilization of beans. In plants from irradiated seeds the fertilization process proceeded without noticeable aberration. In the varieties Armyanskaya Krasnaya, Osetinskaya 302, and Kievskaya 5, within 10 hrs after irradiation, in ⅓ of the seed pods fertilization occurred and within 30 hrs nuclear endosperm and four to multicelled seeds were formed. A dose of 500 R stimulated the formation of seeds and nuclear endosperm in Armyanskaya krasnaya and Ostinskaya 302. For Kievskaya 5, the stimulating dose for the formation of seeds and nuclear endosperm appeared to be 3000 R. (tr-auth)

45843 BIOLOGICAL EFFECT OF THE COMBINED ACTION OF γ-RAYS AND SPACE FLIGHT FACTORS ON BARLEY SEEDS. Nuzhdin, N. I.; Dozortseva, R. L. (Inst. of Biological Physics, Moscow). Zh. Obschch. Biol., 28: 397-412(July-Aug. 1967). (In Russian).

Non-irradiated and irradiated at a dose of 10 and 15 kR from the ^{60}Co source air-dry seeds of wintering barley which were in the dormant and resting state (Ehrenberg L., 1955. Bot. Notiser, 108, 184-215) were flown onboard the "Voskhod-1" space craft. The effect of space flight factors upon the seed germination and yield of cells with chromosome aberrations (dicentric bridges and acentric fragments) was studied. The space flight factors accelerated the germination of seeds which were in the dormant state, leaving unaffected the germination of seeds that were in the resting state. A cytological study of cells of rootlet tips which were in the state of the late anaphase and early telophase of the first mitotic division showed that the space flight factors significantly increased the yield of aberrant cells in seeds which left the dormant state. The combined effect of γ rays and space flight factors produced an additive effect on the yield of aberrant cells. An exposure of test seeds to cysteine solution prior to germination decreased the number of aberrant cells induced both by γ rays and space flight factors. The comparison of the yield of aberrant cells per 1 mrad of γ-quanta or cosmic radiation (assuming that the genetic effect can be induced by cosmic radiation only) indicated that the latter was 4-5 orders of magnitude more efficient than γ-rays. The authors believe that the effect of space flight factors revealed is not related to cosmic radiation. (auth)

45844 A GROWTH OF THE MAIZE SEEDLING ROOT CELLS FOLLOWING IRRADIATION WITH HIGH DOSES OF X-RAYS. I. THE INHIBITION OF CELL DIVISION, THE DURATION AND RATE OF ROOT GROWTH AFTER IRRADIATION. Ivanov, V. B. (Inst. of General and Inorganic Chemistry, Moscow). Tsitologiya, 9: 958-66(Aug. 1967). (In Russian).

Maize seedlings were irradiated with a high dosage (6.25 to 800 kR) of soft x rays. In all cases, the root growth stopped three days following irradiation. The lower the dose, the greater the total increase of root length during this period; the increase was about 2.5 times less at 800 kR than at 6.25 kR. Up to 100 kR the length of mature cortex cells differed from the control ones only a little, but with higher doses of irradiation it noticeably decreased. Mitosis was completely supressed by 50 to 100 kR doses. During the first 8 to 10 hr after irradiation the rate of root growth decreased when doses higher than 25 kR were employed (at 100 kR by 20%, and at 800 kR by 60%). Considering the average rate of root growth during the first ten hours after radiation as standard it was seen that the growth rate in the course of the following growth period decreased by a similar fraction of standard independent of the dose. Considering the total increase of root length after radiation as a standard it may be said that during the same intervals the roots increased in length by the same fraction of this standard at all the doses tested. (auth)

45845 HISTOLOGICAL ANALYSIS OF THE BUDS OF POTATO TUBERS TREATED WITH GAMMA RADIATIONS TO INHIBIT SPROUTING. Mohyuddin, M. (Atomic Energy Centre, Lahore); Hamid, M. A.; Zahoor, M. S. Pakistan J. Sci. Ind. Res., 9: 392-4(Oct. 1966).

Radioinduced degenerative changes in the buds and leaves of potato tubers were investigated. The effective doses for the effect were 6, 8 and 10 Krads. This degenerative effect was dependent upon the storage time. No such effect was observed immediately after irradiation or after 30 days of storage. After 90 days of post-irradiation storage, tunica was found to be intact while corpus was destroyed and at 150 days of storage all the tissues had degenerated and were homogeneous. The procambium did not retain its identity. This degeneration of buds might be one of the possible causes of sprout inhibition in potatoes by the gamma radiation treatment. (auth)

45846 A STUDY OF PLANT CELL ADAPTATION TO HEAVY WATER (D_2O). Den'ko, E. I. (Inst. of Cytology and Botanical Inst., Leningrad). Tsitologiya, 9: 940-8(Aug. 1967). (In Russian).

Pieces of leaves of Tradescantia and Campanula were placed in 50% D_2O or H_2O (the control group). Cells of epidermis treated with D_2O revealed a higher stability to heating while the protoplasmic streaming rate in these was lower than in control group. A longer exposure of leaves in D_2O resulted in elevation of the streaming rate up to the initial level and lowering correspondingly of their thermostability. This suggested that nondividing cells may be able to adapt to D_2O. When cells previously adapted to D_2O were transferred to H_2O, the thermostability level of leaves of both species decreased and moreover, in Tradescantia leaves, the protoplasmic streaming rate appeared to be higher. The increase of sensibility to short-term heating reported for the adapted cells that is characteristic of the resistance of protoplasmic proteins to heat denaturation made it possible to assume that the adaptation to heavy water may be accomplished by a compensatory labilization of protein molecules. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 45593, 45832, and 45836.

45847 EFFECT OF IONIZING RADIATION ON THE METABOLIC PROCESSES OF CHLORELLAE. Shurashkevich, O. H. Ukr. Bot. Zh., 23: 79-81(1966). (In Russian).

Algae of the species Chlorella pyrenoidosa Beyer (wild variety) were periodically irradiated with gamma-rays for a period of several months. The cultures were kept at a temperature of 25 to 27°C under illumination of 200 w/cm^2. A control (unirradiated) culture; cultures regenerated following irradiation (225 krad) and then repeatedly irradiated (same dosage); and cultures regenerated following steady increase of dosage to 225 krad, and then repeatedly irradiated with that dosage were used. It was found that the cells of cultures irradiated with increasing doses of γ-radiation exhibited increased radioresistance (above that of the control group). Such increased radioresistance under steadily increasing doses was observed for the majority of the metabolic processes (metabolism of carbohydrates, organic acids, RNA and DNA), along with distinctive alterations in the metabolic pattern of each substance. Significant disruptions of metabolism were observed in the case of amino acid protein chains. (auth)

45848 BIOPHYSICAL PROPERTIES OF POLIOVIRUS PARTICLES IRRADIATED WITH ULTRAVIOLET LIGHT. Katagiri, Susumu; Hinuma, Yorio; Ishida, Nakao (Tohoku Univ., Sendai). Virology, 32: 337-43(June 1967).

Kinetics of the release of RNA from the purified ^{32}P-labeled polioviron was examined after uv irradiation for antigenic conversion of N to H and for loss of infectivity. With uv irradiation, the decrease of infectivity occurred first, followed by a diminution of ^{32}P-RNA in the viron and finally by a reduction in the amount of N antigen. As was the case with heating, reduction of N antigen was concomitant with acquisition of H antigen. However, with RNAase treatment, the reduction of N antigenicity coincided exactly with the time course of RNA disappearance from the viron. An analysis by sucrose density gradient centrifugation and electron microscopic observation showed that there were four stages in the uv-induced morphological changes and antigenic conversion of N to H. Eventually, 160S virus particles with N antigenicity and containing viral RNA became 80S empty shells with H antigenicity and without viral RNA. With samples irradiated for 10 min, treatment with RNAase resulted in the conversion from 160S to 80S and from N antigenicity to H. The results suggest a possible relation between RNA liberation and antigenic change in the poliovirus particles. (BBB)

45849 PROTECTIVE IMMUNITY PRODUCED BY THE INJECTION OF X-IRRADIATED SPOROZOITES OF PLASMODIUM BERGHEI. Nussenzweig, R. S.; Vanderberg, J.; Mast, H.; Orton, C. (New York Univ., N. Y.). Nature (London), 216: 160-2(Oct. 14, 1967).

Studies with avian malaria have shown that killed sporozoites, and sporozoites inactivated with uv light, can produce partial immunity after injection into birds, but attempts to use killed sporozoites of the rodent malarial parasite Plasmodium berghei to immunize rodents were unsuccessful. The present communication describes studies with a view to determining whether protective immunity to this parasite could be achieved in mice using partially inactivated sporozoites. X-irradiation was chosen as the inactivating agent, at doses of 2 to 15kR. Results indicated a certain degree of protection, and the best protection was conferred by sporozoites irradiated with 6 to 10kR. Protection increased with use of increased number of sporozoites in the immunizing dose. The overall protection rate is indicated by the fact that only 37% of the vaccinated animals became positive after challenge, as compared with 90% of the controls. The protection appears to be stage specific to the extent that it does not alter the course of blood induced infection of the same strain of P. berghei, its effect being limited to the sporozoite stage. (UK)

45850 SOME THEORETICAL AND EXPERIMENTAL DATA ON THE UTILIZATION OF MICROORGANISMS IN RADIOLOGY. Marcovich, H. (Institut Pasteur, Paris). pp 229-36 of Radiobiologie Appliquee. Tome I. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

The conditions necessary for the experimental use of microorganisms in radiobiology are outlined. Techniques for studying the oxygen effects are given. The use of the exponential relation, the broken exponential curve, comparison of two radiosensitivities, and the sigmoid curve in the interpretation of experimental results are described. (J.S.R.)

45851 DESTRUCTION OF MICROORGANISMS BY IONIZING RADIATIONS. APPLICATIONS. Dupuy, P.; Hermier, J.; Mocquot, G. pp 237-62 of Radiobiologie Appliquee. Tome I. Loiseleur, J. (ed.). Paris, Gauthier-Villars, 1966. (In French).

The present state of knowledge on the sterilization of foods, drugs, and small surgical instruments by ionizing radiation is outlined. The evaluation of the sterilization dose, the effect of the nature of the radiation, sensitivity of various microorganisms, resistance induced by radiation, factors modifying the sensitivity of microorganisms, and the effect of the milieu conditions after irradiation are discussed. Some practical examples of the application of radiation to sterilization and pasteurization are given. The destruction of Salmonella in eggs is described. (J.S.R.)

45852 KILLING AND PHOTOREACTIVATION OF STREPTOMYCES GRISEUS CONIDIA BY VACUUM-ULTRAVIOLET AND FAR-ULTRAVIOLET RADIATION (1500 TO 2700 A). Jagger, John; Stafford, R. S.; Mackin, R. J. Jr. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Radiat. Res., 32: 64-92 (Sept. 1967). (ORNL-P-1548).

Conidia of Streptomyces griseus were irradiated in vacuum in the wavelength range 1550 to 2650 A and in aqueous suspension in the range 2000 to 2650 A. Although absorption of the radiation at short wavelengths is an important factor, it was possible to correct for this and to show by a variety of criteria that the chromophore for killing of cells in aqueous suspension is probably nucleic acid in the wavelength region studied. The killing of dry cells, however, becomes inefficient and shows different kinetics at wavelengths below 2400 A, and it was not possible to identify the chromophore in this region. The photoreactivable sector is the same for wet and dry conidia at all wavelengths, being high at 2650 A but dropping at an increasing rate with decreasing wavelength until it falls to zero around 1700 A. This similarity in behavior suggests that the chromophore is the same in both wet and dry cells (namely, nucleic acid) and that the lower efficiency of killing and different kinetics at short wavelengths in dry cells reflects a difference in the efficiency of production, but not in the nature or relative proportions, of the photoproducts in wet and dry cells. (auth)

45853 ON THE SENSITIVITY OF FROZEN MICRO-ORGANISMS TO ULTRAVIOLET RADIATION. Ashwood-Smith, M. J.; Bridges, B. A. (Medical Research Council, Harwell, Eng.). Proc. Roy. Soc. (London), Ser. B, 168: 194-202(Aug. 15, 1967).

The sensitivity of a variety of micro-organisms to the lethal effects of uv irradiation was studied at low temperatures in the frozen state. In the majority of instances micro-organisms were found to be supersensitive to uv irradiation at low temperatures. This increase in sensitivity only occurred when microorganisms were irradiated while frozen and was independent of the effects of freezing and thawing. Supercooled organisms were not supersensitive. Mutation induction by uv irradiation at low temperatures was also enhanced in Escherichia coli, and the observed pattern of supersensitivity was similar to that seen for killing, in that there was a progressive increase in the effectiveness of uv irradiation until a maximum effect was observed at −79°C. At −196°C there was a decrease in the observed supersensitivity both to the lethal and mutagenic effects of exposure to uv. The enhancement factors for the lethal effects of uv irradiation at −79°C compared with irradiation at 22°C for various micro-organisms were as follows: E. coli B/r, 7.0; Staphylococcus aureus, 5.2; Aerobacter aerogenes (r), 5.0; A. aerogenes (s), 5.5; Bacillus subtilis; 5.0; B. subtilis (spores), 2.5; Pseudomonas sp., 7.0; Saccharomyces cerevisiae (diploid), 3.5; Serrati marcescens, 8.5; bacteriophage T_1, 2.5; Micrococcus radiodurans and the spores of the fungus Aspergillus nidulans were not supersensitive to uv irradiation at −79°C. Purified DNA (transforming principle, B. subtilis) was not supersensitive to irradiation at low temperatures. The probability that the damage induced by uv irradiation at low temperatures does not involve the formation of pyrimidine cyclobutane dimers is discussed. (auth)

45854 GAMMA IRRADIATION AND THE MICROBIAL POPULATION OF SOILS AT TWO WATER CONTENTS. Jackson, N. E.; Corey, John C.; Frederick, L. R.; Picken, J. C. Jr. (Phillips Petroleum Co., Bartlesville, Okla.). Contract AT(11-1)-1269. Soil Sci. Soc. Amer., Proc., 31: 491-4(July-Aug. 1967). (COO-1269-12).

Thirty-gram soil samples, in plastic tissue culture dishes (60 × 15 mm), were irradiated with gamma rays (8000 curie Co-60 source) at doses ranging from zero to three million rads. Fungal and bacterial plus actinomycetal counts were made by plating soil suspensions on rose bengal-streptomycin agar and egg albumin agar, respectively. Plates were incubated for four to eight days before counting. The numbers of fungal and bacterial units reflected differences in survival among the microbial populations from soil samples taken at three horizons within field profiles. Microbial counts in the soils at 30% water content (by weight) were generally reduced to zero at lower radiation doses than those in

the air-dry soils. One million rads were required to kill all fungi, but two to three million rads were required to kill all bacteria in a 30 g soil sample. At a given water content, samples with the higher initial microbial populations required greater radiation doses for sterilization than samples with lower populations. For small soil samples, exposure to gamma radiation proved a rapid and efficient method of sterilization. (auth)

Radiosterilization and Radiopreservation

Refer also to abstracts 45845 and 45851.

45855 (ORNL-IIC-11) RADIATION PASTEURIZATION OF FRUITS AND VEGETABLES. A Bibliography. Abdel-Kader, A. S.; Maxie, E. C. (California Univ., Davis); Baker, P. S. (ed.) (Oak Ridge National Lab., Tenn.). Sept. 1967. Contract W-7405-eng-26. 52p. Dep. CFSTI.

A bibliography of 504 references on the use of radiation for pasteurization of fruit and vegetable commodities is presented. Author and a subject indexes are included. (E.R.B.)

45856 (ORO-654) RADIATION PASTEURIZATION OF GULF SHELLFISH. Final Summary Report, January-December 1966. Novak, Arthur F.; Liuzzo, Joseph A. (Louisiana State Univ., Baton Rouge. Dept. of Food Science and Technology). Jan. 15, 1967. Contract AT(40-1)-2951. 27p. Dep. CFSTI.

The results obtained during 1966 emphasize the value of radiation in preserving and extending the shelf life of shrimp and oysters. The successful storage extension of these irradiated shellfish was confirmed by panelists who approved of their quality after 25 and 29 days of ice storage for shrimp and oysters, respectively. These results are consistent with those obtained during the last three years where many hundreds of panelists, both professional and lay, have judged the irradiated product superior to the non-irradiated products. The dose of 0.2 Mrad appears to be satisfactory for the destruction of about 95% of the bacterial population and still maintain the acceptable quality of shrimp and oysters in terms of flavor, odor, and texture. Irradiation of oysters not only preserves their organoleptic properties during ice storage but their nutritive quality is also maintained. A study to ascertain the stability of nutrients in irradiated oysters and subsequent ice storage showed that the nutrients thus far studied (moisture, ash, and glycogen) were not affected by the irradiation. Ash and glycogen decreased slightly during ice storage to 20 days; moisture remained unchanged. Determinations will also be made for protein nitrogen, non-protein nitrogen, crude fat, total carbohydrates, and B-vitamins. Oysters should not be irradiated with dose levels higher than 0.25 Mrad because of undesirable characteristics which develop. Consequently, a project was designed to see if the addition of certain additives, in conjunction with radiation, would reduce the bacterial count lower than irradiation alone. The additives tested were sodium benzoate, sorbic acid, and sodium propionate. Sodium benzoate, as an adjunct to irradiation, resulted in the lowest counts, followed by sorbic acid. Sodium propionate was the least effective at 20 days of storage. Studies were conducted to show the ability of low-level radiation to reduce E. coli and coliform counts in freshly procured oysters. This application is of primary importance because high E. coli and coliform counts, as high total bacterial counts, constitute a health hazard according to recent FDA rulings. Reduction of these organisms just after harvest of oysters would ensure a product of better quality because of the lower counts and subsequently smaller deterioration of the product. Results showed that irradiation at 0.2 Mrad destroyed coliforms in oysters at such a rate as to cause the product to be bacteriologically acceptable. Irradiation of shrimp inoculated with fecal E. coli at various doses destroyed more than 99% of the organisms when an irradiation level of 0.2 Mrad was employed. (auth)

45857 RADIATION PROCESSING IN AGRICULTURE. Nelson, S. O. (Univ. of Nebraska, Lincoln). Trans. ASAE (Amer. Soc. Agr. Eng.), 5: 20-5; 30(1962).

Applications of radiations in the processing of agricultural products and foods are reviewed. Topics discussed include uses of microwave radiation for the control of insects infesting stored grains; the use of r-f dielectric heating to sterilize feed bags; the use of r-f dielectric heating for processing grain; dehydrating vegetables; pasteurization of milk; defrosting frozen vegetables; blanching vegetables; curing tobacco; and for the inhibition of the growth of molds; applications of microwaves for rapid cooking; the use of infrared radiation as a source of heat for brooders for poultry and young animals; the use of visible light as an indicator for automatic fruit and vegetable sorters; applications of ultraviolet radiation for killing airborne and surface-inhabiting bacteria and fungi; and the use of ultraviolet radiation for the treatment of vitamin D precursors in milk on a commercial scale. (C.H.)

45858 FDA REGULATIONS FOR IRRADIATED FOODS AND PACKAGING MATERIALS. Garlock, E. A. (Hazleton Labs., Inc., Falls Church, Va.). Isotop. Radiat. Technol., 4: 137-41 (Winter 1966-1967).

The types of information required by the U.S. Food and Drug Administration to support petitions for clearance of irradiated foods are outlined. A set of guidelines is included. (auth)

45859 ALIMENTARY HYGIENE AND IONIZING RADIATIONS. Morre, J. (Service Veterinaire de la Seine, Paris). Rev. Hyd. Med. Soc., 13: 257-78(1965). (In French).

The contamination of foods by radioactive fallout is discussed and the principal methods used to measure the most dangerous contaminants ^{90}Sr and ^{137}Cs are described. The use of ionizing radiation for the pasteurization and sterilization of foods is discussed in some detail. The general techniques are given. The successes and failures in the preservation of fruits, cereals, potatoes, fish, sea food, eggs, and milk are outlined. (J.S.R.)

45860 GAS CHROMATOGRAPHIC IDENTIFICATION OF IRRADIATED FOODS. Jansson, B.; Loefroth, G. (Univ. of Stockholm). Atompraxis, 13: 254-6(June 1967).

There may be needs for methods to identify whether certain foods have been irradiated or not. One of many available techniques is gas chromatography (GC) that is highly sensitive and that can easily be standardized. It is shown that egg powder irradiated as to simulate industrial application can be distinguished easily from unirradiated egg powder by GC. A similar separation of flour prepared from irradiated and unirradiated wheat seeds was not possible but may become possible after technical improvement. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

Refer also to abstracts 45190 and 45456.

45861 OPTIMAL'NOE UPRAVLENIE GIDROMETALLURGICHESKIMI PROTSESSAMI. (Optimum Control of Hydrometallurgical Processes). Balasanov, G. N. Moscow, Atomizdat, 1967. 212p.

Methods for the optimum control of technological processes are discussed. The requirements in systems of optimum control, the arrangement of tasks for optimum control, introduction of these tasks in the form of game statistics, and methods for the determination of the effects of controls based on the rules of selection in game theory were examined. Algorithms for control of hydrometallurgical processes were developed. Concise data from the probability theory, mathematical statistics, game theory, and statistical solutions are given. (tr-auth)

Corrosion and Erosion

Refer also to abstracts 45069, 45191, and 45192.

45862 (IN-1114) BLENDING RAFFINATES FROM ZIRCONIUM AND ALUMINUM PROCESSES. Newby, B. J.; Hoffman, T. L. (Idaho Nuclear Corp., Idaho Falls). Sept. 1967. Contract AT(10-1)-1230. 13p. Dep. CFSTI.

Raffinates from the reprocessing of both aluminum and zirconium alloy nuclear reactor fuels are produced and stored at the Idaho Chemical Processing Plant. The corrosion and stability to precipitation of a series of blends of these raffinates were evaluated to determine which blended compositions were usable and what storage conditions could be permitted. Several compositions containing 20 percent or less, and 90 percent or more zirconium raffinate were stable for one year. Zirconium fluoride hydrolysis products precipitated in the other blends. Both corrosion and solution stability were adversely affected by storage temperatures of 55°C compared to 35°C, and the latter temperature was recommended. At 35°C the corrosion of Types 304L and 347 stainless steel was acceptable for long-term use. (auth)

45863 (N-67-16606) CAVITATION DAMAGE IN LIQUID METALS (POTASSIUM STUDIES). Technical Progress Report, August 1-October 31, 1966. Preiser, H. S.; Rudy, S. L. (Hydronautics, Inc., Laurel, Md.). Nov. 28, 1966. Contract NAS3-8506). 16p. (NASA-CR-72131; TPR-607-2). CFSTI.

Cavitation damage data are presented showing the rate of volume change as a function of test duration for 316 stainless steel in liquid potassium at 400°F and for TZC alloy in the stress-relieved condition in 600°F potassium. The effect of potassium at 400 to 1200°F on the steady-state zone rate of damage of 316 stainless steel is also given. These tests have been run in pure liquid potassium with measured oxide contamination of 18 ppM or less. The data compared with similar experiments in liquid sodium show that peak rates of damage for 316 stainless steel occur at 600°F for potassium and 400°F for sodium, and that the steady-state volume loss of 316 stainless steel at 400°F in sodium is twice that for 400°F potassium. (auth)

45864 (ORNL-4164, pp 83-94) ELECTROCHEMICAL KINETICS AND ITS APPLICATION TO CORROSION. (Oak Ridge National Lab., Tenn.).

Developments are reported for studies on: kinetics of initiation of crevice corrosion of Ti; kinetics of pit initiation on Ti in chloride solution; effect of flow rate on efficiency of oxidation-reduction reactions in porous and tubular electrodes; use of silver electrodes for chloride analysis in saline waters; determination of kinetics of formation of anodic films; calculation of crystal face effects in anodic film formation; electrochemical behavior of Ti; and inorganic inhibitors of corrosion. (P.C.H.)

45865 (ORNL-TM-1964) COMPATIBILITY OF MATERIALS FOR ADVANCED SPACE NUCLEAR POWER SYSTEMS. Harms, W. O.; Litman, A. P. (Oak Ridge National Lab., Tenn.). Oct. 1967. Contract W-7405-eng-26. 41p. (CONF-671101-3). Dep. CFSTI.

From Annual Meeting of the American Society of Mechanical Engineers, Pittsburgh, Pa.

Results from more than a decade of national effort on compatibility problems in space nuclear power systems, in particular those based on the Rankine cycle are summarized. A review is presented of both the explicit and implicit results which have been gleaned from the many studies of conventional and refractory alloys with potassium and lithium as primary heat transfer fluids and with potassium and cesium as working fluids. The characteristics of single- and multiloop Rankine cycle power systems are described with emphasis on the corrosion problems associated with the components of each system. Recent developments in corrosion theory and experimentation are evaluated insofar as they yield solutions to these problems. Future service requirements and the direction of materials compatibility research are discussed. (auth)

45866 (SC-DR-67-709) PARAMETRIC STUDY OF ION-PLATED ALUMINUM COATINGS ON URANIUM. Bland, R. D. (Sandia Corp., Albuquerque, N. Mex.). Sept. 1967. 23p. Dep. CFSTI.

Ion-plated Al coatings were found to provide excellent corrosion protection on unalloyed depleted U when exposed to an accelerated (100°C at 1 atmosphere H_2O vapor pressure) corrosion test. This study was undertaken to determine what process parameters influence the coating properties and to optimize processing conditions for maximum corrosion protection afforded to the U. The parameters which influence corrosion protection were: substrate precleaning, amount of contamination in the glow discharge, sputter cleaning voltage and pressure, filament contamination, deposition rate, and amount of diffusion, either during plating or in subsequent vacuum heat treatment. A diffusion layer consisting of U-Al intermetallic compounds is believed to provide the corrosion protection in this system. (auth)

45867 CORROSION RESISTANCE, PHYSICO-MECHANICAL, AND ELECTROCHEMICAL PROPERTIES OF V-Nb ALLOYS. Druzhinina, I. I.; Andreeva, V. V.; Stepanova, T. P.; Semenova, E. I. (State Scientific-Research Inst. of Rare Metal Industry, Moscow). Zashch. Metal., 3: 672-5(Sept.-Oct. 1967). (In Russian).

Additions of Nb increases the hardness, specific weight and the specific electric conductivity in V-Nb alloys with up to 40 at. % Nb. Corrosion resistance of V-Nb alloys in sulfuric, hydrochloric, and nitric acids increases with the increase of Nb content. Alloys containing 30 at. % Nb are quite stable in 10 and 57% nitric acid solutions at temperatures up to 100°C. Nb delays the anodic process of V dissolution contributing to alloy passivity in sulfuric acid. (R.V.J.)

45868 STAINLESS STEEL TANKS FOR RADIOACTIVE WASTE STORAGE. Hoffman, T. L. Mater. Protect., 5: No. 10, 13-15(Oct. 1966).

Tanks of 348, 304L, and 316 ELC stainless steels are used for long-term storage of acidic radiochemical wastes produced in the process of recovering U from Al and Zr reactor fuels. Continuous long-range corrosion testing program, using test specimens suspended in the tanks, is described; the performance of the tank materials in Al and Zr raffinates is summarized. Observed corrosion rates were too low to estimate vessel life. Test specimens in vessels will indicate local attack and other signs of failure. (Rev. Met. Lit.)

45869 SOLID-PHASE SURFACE REACTIONS BETWEEN BORIDES, REFRACTORY METALS AND ZrO_2. Samsonov, G. V.; Strashinskaya, L. V. pp 437-44 of Vysokotemperaturnye Neorganicheskie Soedineniya. Kiev, Nauk Dumka, 1965. (In Russian).

The interaction between compact Nb, Ta, Mo, and W and TiB_2, ZrB_2, TaB_2, Mo_2B_5 and W_2B_5 powders at 1000 to 2000°C in a vacuum approximating 5×10^{-2} mm Hg was investigated by metallographic analysis and measurement of the microhardness in the contact zone. ZrB_2 interacted with the metals at 1200°C, TaB_2 at 1400 to 1500°C, and Mo_2B_5 and W_2B_5 at 1300 to 1800°C. TiB_2 was the most resistant in contact with the metals. The temperatures of noticeable interaction were 1400 to 1800°C. As a result of the interaction, borides of the contacting metal or solid solutions of metal borides or of borides in contact with the metal were formed in the contact layer. During the contact of TiB_2 and ZrB_2 with a packing from ZrO_2, the interaction occurred at 1100 and 1500°C, respectively. (Rev. Met. Lit.)

Preparation and Fabrication

Refer also to abstracts 46989 and 47012.

45870 (ORNL-TM-1935) HIGH-PURITY SHAPE CASTING WITH AN ELECTRON-BEAM FURNACE. Dean, C. W.; McDonald, R. E. (Oak Ridge National Lab., Tenn.). Oct. 1967. Contract W-7405-eng-26. 19p. Dep. CFSTI.

A casting technique was developed for use with the electron-

beam furnace that permitted a molten charge of high-purity metal to be drop-cast into a cylindrical or rectangular chill mold. Subsequent fabrication was easier and less expensive than previous methods because of the more desirable ingot shapes. In addition, a higher material yield was realized. This drop-casting technique and melting equipment have been used to cast fabricable shapes of Ti, Zr, Nb, V, Ta, W, Mo, and their alloys. (auth)

45871 GROWING PURE SINGLE CRYSTALS OF REFRACTORY METALS AND MEASUREMENT OF THE HALL EFFECT ON THESE. Brilliantov, N. A.; Kachinskii, V. N.; Starostina, L. S. pp 37-40 of Vysokotemperaturn Neorgan Soedineniya. Kiev, Nauk Dumka, 1965. (In Russian).

Refractory-metal single crystals were prepared by floating-zone processing in a vacuum with heating of the zone by electron bombardment. The single crystals grown from initial materials of an increased purity had a ratio of resistivities approximating 10,000 for W and 3000 for Mo. The Hall effect (the even and odd components) and also the anisotropy of resistivity in a magnetic field were measured on a W single crystal. (Rev. Met. Lit.)

45872 PILOT PLANT PRODUCTION OF NUCLEAR-GRADE ZIRCONIUM SPONGE FROM INDIAN ZIRCON. Subramanyan, R. B.; Sundaram, C. V. Trans. Indian Inst. Metals, 19: 9-20 (Mar. 1966).

Pilot-plant production of nuclear-grade Zr sponge on a 1-kg scale from Indian zircon is described. The flowsheet incorporates multiple recrystallization of potassium double fluorides for the removal of Hf and other impurities from Zr. The purified potassium zirconium fluoride is converted to zirconium dioxide, which is chlorinated to produce zirconium tetrachloride. Mg reduction of the chloride followed by vacuum distillation gave Zr metal conforming to nuclear specifications. Operating conditions for optimum yields and purities in the various steps of the flowsheet are presented in detail. (Rev. Met. Lit.)

45873 AUTOMATICALLY-WELDED STAINLESS STEEL COATINGS IN NUCLEAR STRUCTURES. Bernioller, J. Soudage Tech. Connexes, 20: 375-94(Sept.-Oct. 1966). (In French).

Automatic welding methods are described for the stainless steel coating of water-cooled reactor casings. The various methods used in nuclear construction include series-arc welding and twinned arc welding with oscillation for solid flux, and welding with cooling wire and oscillation for gaseous flux. A technical study is made of the welded stainless steel coating, specifying the physio-chemical properties of the parent and the filler metal, which play an important part in the interpenetration of the two metals. An account is given of the essential principles of the solutions to be adopted to control and limit the dilution of the parent metal. (auth)

45874 GAS EVOLUTION IN PLUTONIUM REDUCTIONS. Conner, W. V. (Dow Chemical Co., Golden, Colo.). J. Less-Common Metals, 13: 219-23(Aug. 1967).

H_2 is formed in Pu reduction vessels from the reaction of Ca with water and HF. The H_2 formation can result in pressures which are 3 to 4 times the pressure expected from heating the Ar left in the vessels following purge using this gas. The H_2 reacts with Ca to form CaH_2 at 250 to 300°C. It will not react with Pu if Ca is present, and normally does not present a problem. A potential problem can exist if air is left in a reduction vessel as a result of an improper purge. (auth)

45875 DEVELOPMENT OF TEXTURE IN ZIRCONIUM ALLOY TUBES. Cheadle, B. A.; Ells, C. E.; Evans, W. (Chalk River Nuclear Labs., Ont.). J. Nucl. Mater., 23: 199-208(1967).

The crystalline texture of a large number of Zr alloy tubes has been related to the fabrication history. The texture developed is controlled by the direction of major strain in the final stages of fabrication. A production route can now be specified to achieve the desirable texture of basal plane normals oriented radially in the tube. (auth)

45876 MONTAZH I SVARKA TRUBOPROVODOV IZ KORROZIONNO-STOIKIKH STALEI V ATOMNOI PROMYSHLENNOSTI. (Fitting and Welding of Pipes of Corrosion-Resistant Steels in Atomic Energy). Yurchenko, Yu. F.; Guma, V. V.; Roshchin, V. V.; Grinenko, V. I.; Popenko, V. S.; Kurkumeli, A. A. Moscow, Atomizdat, 1966. 252p.

A brief review is given on the installation and welding of corrosion-resistant steel pipes used in the corrosive media of nuclear industrial installation. Welding technology, automatic handling of welding equipment, and welding-assembly mechanisms are discussed. Technical and economic index of recommended welding methods is included. 108 references are included. (R.V.J.)

45877 PROCESS FOR THE MANUFACTURE OF PRODUCTS OF BERYLLIUM OR BERYLLIUM ALLOY. Mallen, Jose; Weisz, Michel (to Commissariat a l'Energie Atomique). British Patent 1,085,804. Oct. 4, 1967. Priority date Oct. 25, 1963, France

A process for the production of Be or Be-alloy products, particularly tubes, consists of subjecting the cast starting material, optionally subjected to a compression, to a thorough plastic hot-working, such as extrusion in one or more steps. Optionally, the hotworking is followed by warm drawing, and the product is stress relieved at 550 to 750°C while a tensile force is imparted to straighten the extruded metal or metal alloy. The product is finally subjected to a controlled recrystallization annealing. (B.L.M.)

45878 ZIRCONIUM ALLOY. Baque, Pierre; Darras, Raymond (to Commissariat a l'Energie Atomique). British Patent 1,083,057. Sept. 13, 1967. Priority date Aug. 27, 1965, France.

A ternary Zr alloy suitable for use in pressurized CO_2-cooled reactor consists of 0.5 to 6 wt % Cu; a total of 0.1 to 5 wt % of at least one of the additives from the group consisting of Mg, Ce, Pt, and Mn; and the remainder being nuclear grade Zr. (B.L.M.)

45879 PROCESSES FOR THE MANUFACTURE OF BERYLLIUM PRODUCTS. Mallen, Jose; Weisz, Michel (to Commissariat a l'Energie Atomique). British Patent 1,085,034. Sept. 27, 1967. Priority date Oct. 25, 1963, France.

A process for the manufacture of Be products, particularly Be tubes suitable for fuel element cans, consists of extruding an ingot of Be, optionally subjected to compression, followed by forging. The forging is carried out in a press under a thick steel can. Optionally, the extrusion can be carried out under a soft steel can and may be followed by a second extrusion of the impact type with the metal being treated with a thin layer of Ag. (B.L.M.)

45880 ELECTROREFINING OF PLUTONIUM. (to U. S. Atomic Energy Commission). British Patent 1,084,936. Sept. 27, 1967. Priority date Aug. 4, 1965, United States.

A process for electrorefining Pu consists of melting a mixture of $MgCl_2$, KCl, and NaCl with impure Pu to form fused electrolyte, maintaining the fused mixture at 700 to 830°C, and simultaneously stirring the mixture for a period of from 30 to 120 min to acquire a supply of Pu ions in the melted electrolyte, then initiating electrolysis through the electrolyte using the impure Pu as the anode. The electrolyte is an equimolar mixture of the chlorides. (B.L.M.)

45881 HIGH TEMPERATURE BRAZING ALLOYS FOR TUNGSTEN AND TANTALUM AND ALLOYS THEREOF. (to U. S. Atomic Energy Commission). British Patent 1,085,480. Oct. 4, 1967. Priority date Oct. 22, 1965, United States.

A brazing alloy for joining a refractory metal, either Ta or W, and alloys containing a predominant amount of the metal to themselves and one another consists of 10 to 35% Ru, 0 to 40% Re, and 45 to 90% W. The brazing alloy melts at 2300 to 2800°C. (B.L.M.)

45882 OXIDATION RESISTANT NIOBIUM. Tarr, Charles O.; Lever, Ray C.; Wukusick, Carl S. (to U. S. Atomic Energy Commission). U. S. Patent 3,341,307. Sept. 12, 1967.

A high-temperature oxidation-resistant refractory article of Nb was prepared. The article comprises a porous Nb skeleton having a low melting Al, Cr, Si, and Ti alloy dispersed in said skeleton. The dispersion is treated to form Nb–Al intermetallic compounds on the porous Nb surfaces. The resulting article is made oxidation resistant in oxidizing atmospheres at temperatures as high as 2500°F without destruction of the basic properties possessed by Nb. (AEC)

45883 IMPROVEMENTS IN OR RELATING TO NUCLEAR FUEL ELEMENTS. Antill, John Edward (to United Kingdom Atomic Energy Authority). British Patent 1,081,512. Aug. 31, 1967. Filed Jan. 22, 1965.

A metallic container, suitable for use as an AGR fuel element at temperatures circa 800°C, consists of an Fe-base Ni alloy, or a Ni-base Fe alloy with a thin outer coating of an oxidation resistant material such as Al, Al_2O_3, Cr, Ni, Si, or one of a variety of intermetallic compounds. A flame-sprayed diffusion barrier may be provided between the container and the protective coating. It is specified that the suitability of the coating is dependent on the nature and compatibility of the fuel container, thermal stresses, and type of coolant. It is also desirable that the coatings have a low thermal neutron capture cross section. Coatings may be applied by vapor phase deposition, electroplating or other suitable techniques. (P.G.C.)

45884 METHOD OF PREPARING A URANIUM ARTICLE FOR A PROTECTIVE COATING. Anderson, P. D.; Coronado, P. R.;

Berry, L. M. (to U. S. Atomic Energy Commission). U. S. Patent 3,341,350. Sept. 12, 1967.

A method is described for obtaining greatly improved coatings on metal articles by preliminarily immersing in a solution of a metallic chloride (particularly stannous chloride) with an acid and water. (AEC)

45885 IMPROVEMENTS IN OR RELATING TO ZIRCONIUM ALLOYS. Child, Henry Cave; Dalton, Alan Leslie (to Birmingham Small Arms Company Ltd.). British Patent 1,084,250. Sept. 20, 1967. Filed Nov. 9, 1963.

A Zr-base alloy intended for use at high temperatures consists of Ta, from 4 to 10 wt %, and/or W from 0.5 to 5 wt % with the total alloying elements not exceeding 10 wt %. Also, the alloy may include one or more of the following alloying elements with the accumulative total not exceeding 5 wt %: Cu, Mo, Sn, Fe, Ni, Cr, Co, and Si. (B.L.M.)

Properties Evaluations

Refer also to abstracts 45136, 45307, 45952, 46005, 46837, and 46858.

45886 (EURAEC-1897) A STUDY OF SOME METAL OXIDATION PROBLEMS. SOLID-GAS REACTIONS STUDY SECTION: "OXIDATION OF METALS." Final Report No. 3. (Brussels Univ. (Belgium). Faculte des Sciences). [1965]. Contract 079-64-10TEEB(RD). 26p. (EUR-3389). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

The oxidation reactions of Al and Ni by Oxygen, and Cu by iodine are discussed. The determination of the nucleation and growth phase of each system is presented. (D.C.C.)

45887 (IS-T-194) AN INVESTIGATION OF THE CHARACTERISTICS OF HYDROGEN CHARGED VANADIUM METAL. Sherman, Donald Harold (Ames Lab., Iowa). Aug. 1967. Contract W-7405-eng-82. 76p. Dep. CFSTI.

Thesis.

Specimens of 99.8% iodide V with 110 micro grain diameter were thermally charged to a H_2 concentration of 50 ppM and tested at twelve temperatures over the temperature range 77°K to 298°K at a strain rate of 0.005 min^{-1}. A detailed percent reduction in area versus temperature curve was obtained in order to establish the ductile to brittle to ductile transition temperatures. The temperature dependence of the yield stress and fracture stress was determined. Five grain size groups (26, 41, 61, 110, and 174 micron grain diameter) of uncharged V and V charged with 50 ppM H_2 were tested at 77°K, 193°K, and 298°K to determine the grain size dependence of the yield stress and flow stress. The experimental evidence of the present investigation indicated that the mechanism controlling the embrittlement of V must greatly reduce the effective surface energy associated with fracture. From this result, the following two essential features of an embrittlement mechanism which successfully explain the ductile to brittle to ductile transition behavior of H_2 charged V were derived. The mechanism requires a large reduction in the cohesive strength of the metal across the cleavage plane. This allows crack propagation to occur with plastic flow virtually eliminated in the material near the propagating crack thereby allowing for a large reduction in the effective surface energy associated with crack propagation. The mechanism depends upon the diffusion of H_2 to a localized region. This H_2 segregation provides the reduction in the cohesive strength of the material. The diffusion process also establishes the temperature limits of the brittle region. (auth)

45888 (N-67-25863) MODIFIED EUTECTIC ALLOYS FOR HIGH-TEMPERATURE SERVICE. Progress Report. Vishnevsky, C.; Ramseyer, S. F.; Wallace, J. F. (Case Inst. of Tech., Cleveland, Ohio. Dept. of Metallurgy). Mar. 1967. 52p. (NASA-CR-83874). CFSTI.

Progress is reported in a program directed toward the control of cast structures in order to obtain improved high-temperature properties. Using a base alloy of Co–35W–3Cr, it was found that the atomic ratio of Ti plus Zr to C determined both the type and morphology of the second phases. The atomic ratio of Ti and Zr to C also affected stress rupture properties, with optimum results obtained with a ratio of 0.76. Directional solidification of four Co–W base alloys exerted a complex influence on structure and stress-rupture behavior. In the Co–35W unmodified alloy the structure was aligned axially in the stress-rupture specimens and properties were enhanced over the entire range of stress investigated. For Co–45W, both modified and unmodified, conventionally cast specimens exhibited longer lives at high stresses, but at low stresses the directionally solidified structures were superior. In the Co–35W modified alloys directional solidification altered considerably the shape and distribution of microconstituents leading to a reduction in stress-rupture life. (STAR)

45889 (N-67-25961) HIGH-TEMPERATURE PROTECTIVE COATINGS FOR REFRACTORY METALS. Progress Report, October 21, 1966–January 21, 1967. Rexer, J. (Union Carbide Corp., Parma, Ohio. Carbon Products Div.). Contract NASw-1405. 9p. (NASA-CR-83867; PR-3). CFSTI.

Polishing and etching techniques needed to reveal the W–Ir reaction zone boundaries were developed. The total reaction zone thickness was measured for heat-treated samples. Sections of other heat treated samples were metallographically polished and etched. Mo–Ir diffusion couples were hot pressed and sectioned for metallographic examination. Difficulties were experienced during attempts to electroplate Ir on Nb and Ta. A flash coating of Ni was deposited on the substrate materials to reduce the chemical activity of these metals in the presence of the molten cyanide electrolyte; the Ir coating was then deposited over the Ni. Tabulated diffusion data for the W–Ir system are presented. (STAR)

45890 (UCRL-17799) RESISTOMETRIC OBSERVATION OF THE ANNEALING CHARACTERISTICS OF A TENSILE LOADED Cu-Al ALLOY. Malatesta, Ronald Paul (California Univ., Berkeley. Lawrence Radiation Lab.). Sept. 1967. Contract W-7405-eng-48. 25p. Dep. CFSTI.

Thesis.

A highly sensitive resistance measurement apparatus was set up to observe the effect on the electrical resistance of alloying Cu with Al and to observe recovery at low temperatures after cold work. The electrical resistivity ρ_0 was shown to be proportional to the square of the scattering charge z of the alloying element. An increase in resistance was detected in specimens annealed at 90°K and 113°K. (auth)

45891 (WANL-TME-1610) FRACTURE TOUGHNESS OF BERYLLIUM. Harrod, D. L.; Hengstenberg, T. F.; Manjoine, M. J. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). June 1967. Subcontract NP-1. 40p. Dep. CFSTI.

The opening mode plane strain fracture toughness of vacuum hot pressed S-200 grade Be was determined in the temperature range –320°F to 500°F. Two different test specimen designs were employed, and a number of other variables were investigated to a limited extent. The temperature dependence of fracture toughness was found to be approximately linear between –320°F and room temperature. Fracture toughness was nearly isotropic, and was not dependent upon loading rate for crosshead speeds up to 2 in./min. Heat treatments were found to have a pronounced effect on fracture toughness. Fractographic observations failed to reveal any correlation between fracture toughness and the various test variables, including the response to heat treatment and the effect of test temperature. (auth)

45892 (WANL-TME-1619) CRYOGENIC AND AMBIENT TENSILE AND COMPRESSION PROPERTIES OF HOT-PRESSED BLOCK BERYLLIUM. Kesterson, R. L. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). June 1967. 45p. Dep. CFSTI.

The tensile and compression properties of S-200 grade Be were investigated in the temperature range of +70°F to –320°F. This hot-pressed block material is presently being used for both sector and ring types of NERVA outer reflectors. The objectives of this investigation included: statistical comparison of the mechanical properties of ring and sector material; statistical comparison of the lot to lot variation in the mechanical properties of hot-pressed Be; statistical study of the testing temperature effect on the mechanical properties; and study of the notched tensile behavior. The experiment was designed such that a statistical data analysis would produce an optimum amount of information. The results from the analysis were used to develop stress-strain curves with 75%, 90%, 95%, and 99% tolerance limits and with a 90% confidence factor. The results indicate that on a statistical basis no real difference exists between the cryogenic mechanical properties of the ring and block pressings. However, there is less variance in properties of ring-type pressings, and thus this type of Be pressing is favored. (auth)

45893 DISINTEGRATION OF β-SOLID SOLUTION OF Zr–Mo–Fe ALLOYS. Petrova, L. A.; Grankova, L. P. (Inst. of Metallurgy, Moscow). Izv. Akad. Nauk SSSR, Neorg. Mater., 3: 824-31(May 1967). (In Russian).

The decay mechanism of β-solid solutions of the alloy Zr-7.5 wt % Mo-1 wt % Fe as a result of annealing at 200, 300, and 500°C for 100 hr and at 400°C for 200 hr was investigated. It was established that the β-solid solution of the Zr alloys decays by the scheme: $\beta \rightarrow$ (partially enriched) + β (more enriched) + $\Omega \rightarrow \beta$ (enriched) + $\Omega \rightarrow \beta$ (enriched) + $\alpha \rightarrow \alpha$ + chemical compound. Separation of the Ω phase in the decay process was accompanied

by the appearance of a large quantity of displacements in the β granules, which to the extent of the increase of the annealing temperature and the aging time are decreased and at last completely disappear. The maximum hardness of the alloy occurred in the $\beta + \Omega$ region. (tr-auth)

45894 STRUCTURAL DEPENDENCE OF THE PROPERTIES OF TUNGSTEN CARBIDE–COBALT ALLOYS. Fischmeister, Hellmut; Exner, Hans Eckart. Arch. Eisenhuettenw., 37: 499-510(June 1966). (In German).

The structure dependence of magnetic and mechanical properties of tungsten carbide-cobalt alloys with varying Co content (10 to 25%) and different carbide grain size (1.1 to 2.1μ) were investigated quantitatively by linear analysis of electron microscope micrographs. The coercive force and the remanence depended only on the size of the interface between the magnetic and nonmagnetic phases in the unit volume of the first and thus on the median layer thickness of the Co phase. A close correlation was obtained between Vickers hardness and the structural characteristics. The crack formation energy (Palmquist) exhibited a qualitatively opposite progress to hardness in relation to the Co content and the Co layer thickness. The bending strength reached a maximum at a median Co layer thickness of about 1 micron, with increasing Co contents and carbide grain sizes. A tentative hypothesis of the mechanism of mechanical behavior is presented, according to which the strength of the alloy is determined by statistically distributed peaks of tensile stress in the binder phase. These peaks have their origin in the difference in the contraction on cooling of the carbide and Co phases. (Rev. Met. Lit.)

45895 INVESTIGATION OF DAMPING IN NITRIDED Fe–Mo AND Fe–V ALLOYS. Koster, W.; Horn, W. Arch. Eisenhuettenw., 37: 245-51(Mar. 1966). (In German).

Damping measurements were performed with a torsion pendulum at a free oscillation frequency of 1.3 Hz on wire specimens of pure Fe containing 1 and 2.6% Mo and 0.75 and 4.3% V. The specimens were annealed in vacuo at 940°C and furnace-cooled to 150°C. After denitriding and decarburizing in humid H_2, they were nitrided at 580°C in N_2-NH_3 and given a homogenizing anneal at 580°C. The results showed that in addition to the Snoek maximum, another damping maximum exists at 200 and 150°C. It is likely that its mechanism is similar to that in the deformation damping of Fe–N and Fe–C alloys. Specimens quenched in water from 800°C and higher temperatures, exhibited a third maximum at 80 to 100°C, which is explained by the martensitic structure. (Rev. Met. Lit.)

45896 A NOTE ON THE TEMPERING BEHAVIOR OF A Ti–9 WT. PERCENT Ta ALLOY QUENCHED FROM BETA REGION. Yamane, Toshimi; Ueda, Jitsuhiko. Trans. Jap. Inst. Metals, 7: 95-8(Apr. 1966).

Changes in dislocation arrangement and twin faults formation by quenching and tempering of a Ti–9% Ta alloy were investigated by means of internal friction measurements and transmission electron microscopy. Typical needle-like martensite structures were produced by quenching from the beta region. By transmission electron microscopy, a number of dislocations and $(10\bar{1}1)$ transformation twins were observed. It is suggested from the internal friction measurements that annihilation of dislocations and twin faults occurs during tempering at about 300 to 400°C. (Rev. Met. Lit.)

45897 STEADY-STATE CREEP OF POLYCRYSTALLINE ALPHA ZIRCONIUM AT ELEVATED TEMPERATURES. Ardell, A. J. (California Inst. of Tech., Pasadena); Sherby, O. D. Trans. Met. Soc. AIME, 239: 1547-56(Oct. 1967).

The elevated-temperature steady-state creep behavior of polycrystalline α Zr was studied in vacuo under constant tensile stress. The experiments were conducted from 660° to 845°C over the stress range 870 to 5400 psi. The steady-state creep rate, $\dot{\epsilon}_s$, of α Zr was found to be related to the applied stress, σ, and temperature, T, by the equation $\dot{\epsilon}_s = C \exp(\beta\sigma) \exp\{-(Q + \eta/\sigma)/RT\}$ where C is a constant. Two interpretations of the data are considered, each requiring different values of the parameters β, Q, and η. It is shown that this formula can be derived using Gilman's phenomenological equation relating dislocation velocity to the shear stress for the case where dislocation mobility is limited by the nucleation of kink motion. From the fundamental dependence of strain rate on dislocation velocity and the density of mobile dislocations, the factor $\exp(\beta\sigma)$ can be related to the stress dependence of the dislocation density, and Q to the energy of kink formation. Factors favorable to the observation of the unusual stress-dependence of $\dot{\epsilon}_s$ for α Zr are discussed and it is shown that the anomalously rapid rates of self-diffusion and the low modulus on the principal glide system are primarily responsible for the anomalous creep behavior. Metallographic observations are presented and discussed with reference to the overall creep behavior. (auth)

45898 DIFFUSION CREEP IN ZIRCONIUM AND CERTAIN ZIRCONIUM ALLOYS. Bernstein, I. M. (U. S. Steel Corp., Monroeville, Pa.). Trans. Met. Soc. AIME, 239: 1518-22(Oct. 1967).

The steady-state creep behavior of Zr and Zircaloy-2 was examined in the temperature range 520 to 620°C. At low stresses the creep rates were characterized by a linear stress dependence; at higher stresses the stress dependence was much more pronounced. Temperature-cycling tests yielded values for the activation energy for creep. Various theories were examined in the light of the experimental results and it was concluded that the low-stress creep behavior is the result of the stress-directed diffusion of vacancies along grain boundaries. (auth)

45899 PERMEABILITY OF TUNGSTEN TO HYDROGEN FROM 1300° TO 2600°C AND TO OXYGEN FROM 2000° TO 2300°C. Aitken, E. A. (General Electric Co., Pleasanton, Calif.); Brassfield, H. C.; Conn, P. K.; Duderstadt, E. C.; Fryxell, R. E. Trans. Met. Soc. AIME, 239: 1565-74(Oct. 1967).

Permeation rates of H_2 through arc-cast W were measured at temperatures from 1300° to 2600°C with H_2 pressure differentials of 1 and 0.1 atm across isothermal membranes. Rates were nearly proportional to square root of pressure, were inversely proportional to membrane thickness, and were temperature-dependent according to the equation: $P = 33.2 \exp(-33{,}000 \pm 1000/RT)$ where P = permeation coefficient in cu cm (stp)-mm per sq cm-min-atm$^{\frac{1}{2}}$, R = gas constant in cal per mole-°K, T = absolute temperature in °K. Permeation rates of O_2 through W were determined in the range 1965° to 2300°C and at calculated O_2 pressures of 3.3×10^{-4} to 2.2×10^{-5} atm using sealed capsules containing known quantities of tungsten oxide. Permeation coefficients obtained in this manner had a temperature dependency in the range of 40 to 45 kcal per mole of permeating species. Permeation coefficients for O_2 were higher than those for H_2 in the temperature range studied. This is probably the result of O_2 solubility being much greater than H_2 solubility at these temperatures at a given pressure. (auth)

45900 SOLUBILITY OF CHROMIUM IN LIQUID SILVER AND MOLYBDENUM AND TUNGSTEN IN LIQUID TIN. Allen, B. C. (Battelle Memorial Inst., Columbus, Ohio). Trans. Met. Soc. AIME, 239: 1026-29(July 1967).

The solubility of Cr in liquid Ag and that of Mo and W in liquid Sn have been determined by equilibrating the liquid in a crucible of the solute metal. Generally the weight of solute in solution was determined both chemically and from crucible weight losses. The resulting weight percent solubility of Cr in Ag as a function of absolute temperature T is given by $\log w = -6660/T + 4.02$ in the range 960° to 1445°C, and that of Mo in Sn by $\log w = -5050/T + 1.79$ in the range 1200° to 2200°C. The values appear unaffected by minor changes in solute composition. Calculations are made of the partial molar heat and excess entropy of mixing. The estimated solubility of W in Sn is 0.001% at 2000°C. Evidence is presented that Mo dissolves in Sn without compound formation and that W and Sn form $W_{10}Sn$. (auth)

45901 ELEVATED-TEMPERATURE FATIGUE OF TZC MOLYBDENUM ALLOY UNDER HIGH-FREQUENCY AND HIGH-VACUUM CONDITIONS. Honeycutt, C. R.; Martin, T. F.; Sawyer, J. C.; Steigerwald, E. A. (TRW Inc., Cleveland). Amer. Soc. Metals, Trans. Quart., 60: 450-8(Sept. 1967).

High-frequency fatigue tests were conducted in a high-vacuum environment on recrystallized molybdenum-base alloy TZC at 1800° to 2200°F. The results indicated that in this temperature range no well-defined endurance limit existed. Fatigue strengths at 2200°F and 10^9 cycles were as low as 16,000 psi. The application of a cyclic load to a statically loaded specimen produced a marked acceleration in the degree of specimen extension. This increase was characterized by a relatively rapid extension during the first 30 min of testing followed by a period of steady state creep which was approximately two orders of magnitude greater than the creep rate observed under a comparable static peak stress. (auth)

45902 EFFECT OF ALLOYING ON THE NATURE OF THE INTERATOMIC INTERACTION IN NIOBIUM-BASE SOLID SOLUTIONS. Tarasov, N. D.; Ul'yanov, R. A.; Mikhailov, Ya. D. pp 55-62 of Vysokotemperaturn Neorgan Soedineniya. Kiev, Nauk Dumka, 1965. (In Russian).

The effects of up to 10% W, Mo, Ta, Ti, Re, Pd, Zr, Cr, and Ir on the properties of Nb were studied. Alloying in the region of the solid solutions increased the tensile strength and reduced elongation at room temperature. Additions of Cr, Re, Zr, and Ti were the most effective. The tensile strength of the alloy Nb–2.3% Cr was about 57 kg/mm^2 and 80%, respectively. With increased con-

centration of the solid solutions of Nb with Ta, W, Re, Mo, Ir, and Zr, the alloy coefficient of linear expansion decreased, and elasticity and the characteristic temperature increased. This was indicative of an increase in the forces of interatomic interaction. At 1100°C the alloy Nb–2.3% Cr was somewhat superior to the alloy Nb–10% Mo as regards tensile strength and elongation. (Rev. Met. Lit.)

45903 DEPENDENCE OF THE MECHANICAL AND HEAT RESISTING PROPERTIES OF ST1 TITANIUM ALLOY ON HEAT TREATMENT. Livanov, V. A.; Nartova, T. T.; Fainbron, S. M.; Ryabova, R. M.; Fridman, Z. G. pp 251-7 of Novye Issled Titan Splavov. Moscow, Nauk, 1965. (In Russian).

The temperature of the phase transformation alpha ⇌ alpha-beta of the ST1 alloy was determined at 1000 to 1050°C. The best heat treatment to obtain improved plastic properties for ST1N was annealing at 800°C with cooling air, and for ST1V, water quenching from 1000°C. The ST1 alloy has a high short-time and long-time heat resistance up to 600 to 700°C. The short-time tensile strength of ST1N at 700°C is 43 to 50 kg/mm^2 and in ST1V it reaches 53 to 70 kg/mm^2. The maximum stress at 600°C for 100 hr of creep-rupture tests of ST1N is 25.5 kg/mm^2 and for ST1V 28 kg/mm^2. At 700°C maximum stress of ST1N is 6 kg/mm^2 and that of ST1V 8 kg/mm^2. The heat treatment has an effect on the stress-rupture strength and creep strength of the ST1 alloy. After heating to 1050 to 1150°C and holding for 1 hr with subsequent cooling air or water ST1N has the highest creep strength at 750°C. The ST1 alloy can be recommended for work at 600 to 700°C for a long time and at 800°C for a short time. (Rev. Met. Lit.)

45904 MAGNETIC PROPERTIES OF RARE EARTH–MANGANESE COMPOUNDS. Kirchmayr, Hans R. IEEE (Inst. Elec. Electron. Eng.), Trans. Magnet., MAG-2: 493-9(Sept. 1966).

The rare earth (RE)–Mn alloys and compounds are interesting, especially with respect to their magnetic properties, since Mn is the first element of the 3d metals, which forms intermetallic compounds with RE metals. The amalgam process was used throughout for preparing single-phased, magnetically pure specimens. Magnetic measurements on the compounds RE_6Mn_{23}(RE = Gd, Dy, Er, Y), $REMn_{12}$(RE = Gd, Dy, Er), and $REMn_2$(RE = Gd, Dy, Er) are reported. In all of these compounds, a ferro-, ferri-, or antiferromagnetic coupling of the moments was observed. The magnetic properties of these compounds are discussed and can be explained by transitions between several different ferri- or ferromagnetic states, depending on field strength and temperature. (Rev. Met. Lit.)

45905 CHARACTERISTICS OF PRECIPITATION IN COPPER–ZIRCONIUM ALLOYS CONTAINING FROM 0.003 TO 0.26 PERCENT Zr. Wortman, O.; Sarrate, M.; Obrutsky, D. Met., ABM (Ass. Brasil. Metais), 22: 475-9(June 1966). (In Portuguese).

Results of investigating kinetics of precipitation indicate that properties of these alloys make them suitable for applications as electric conductors, commutators, transformers, etc.; they can also be used advantageously as material for resistance welding electrodes, assuring excellent durability of the latter. (Rev. Met. Lit.)

45906 THREE-STAGE HARDENING IN TANTALUM DEFORMED IN COMPRESSION. Mordike, B. L.; Rudolph, G. (Univ. of Liverpool). J. Mater. Sci., 2: 332-8(July 1967).

High-purity Ta single crystals were deformed in compression at various temperatures and strain rates. The shape of the stress/strain curve is strongly dependent on orientation but, for certain orientations, the curve could be divided into three stages for tests conducted over a narrow range of temperatures and strain rates. The work-hardening rates for the various stages were determined and compared with those obtained by other workers. Strain-rate-change and temperature-change experiments were evaluated to yield values of activation energy and activation volume. The values obtained were comparable with those obtained in other investigations on polycrystalline Ta or on single crystals where three-stage hardening was not observed. (auth)

45907 A NOTE ON CREEP-RUPTURE MECHANISMS IN REACTOR GRADE URANIUM. Taplin, D. M. R.; Cocks, G. J. (Univ. of Melbourne). J. Nucl. Mater., 23: 245-8(1967).

Results are summarized for studies on the mechanisms of creep-rupture in standard adjusted U (500 ppM Fe, 250 ppM Al, 600 ppM C, 300 ppM O, 20 ppM N) specimens over the temperature range 250 to 600°C. (H.D.R.)

45908 HARDNESS ANOMALIES IN BETA PLUTONIUM. Bowman, F. E. (Battelle Memorial Inst., Richland, Wash.). J. Nucl. Mater., 23: 347-8(1967).

The effect of the parent phase (α or γ) on the macrohardness of as-cast, electrorefined Pu was measured over the range of β stability for both types of material. (H.D.R.)

45909 PRECIPITATION STRENGTHENING OF Fe-6 AT. PERCENT Mo. Urakami, A.; Marcus, H. L.; Meshii, M.; Fine, M. E. (Northwestern Univ., Evanston, Ill.). Amer. Soc. Metals, Trans. Quart., 60: 344-51(Sept. 1967).

Precipitation of Fe_2Mo at 550°C in Fe-6 at. % Mo results in a substantial increase in σ the room temperature yield stress by 14 kg/mm^2. Using Orowan's theory for the force required to bend dislocations between particles a spacing of 1900 A was computed; the measured spacing between particles was 1800 A. There is also a drastic increase in the rate of work hardening; the initial $d\sigma/de$ increases from 150 to 1600 kg/mm^2. The thermal component of the shear stress τ_T is not affected by the precipitate but it is affected by dissolved Mo. In fact, addition of 1.5 at. % Mo reduces τ_T with essentially no further change to 6 at. % dissolved Mo. At room temperature the yield stress increases essentially linearly with dissolved Mo but at 77°K due to the reduction in τ_T alloy softening first occurs. The effective activation enthalpy at high τ_T, that is low test temperature, for Fe-6 at. % Mo is smaller than for Fe. This is interpreted in terms of Weertman's theory for "weak" attraction between solute atoms and dislocations. (auth)

45910 EFFECT OF SMALL COLUMBIUM ADDITIONS ON THE PROPERTIES OF SOME AUSTENITIC STAINLESS STEELS. Schaller, F. W.; DePaul, R. A. (International Nickel Co., Inc., Suffern, N. Y.). Amer. Soc. Metals, Trans. Quart., 60: 289-94(Sept. 1967).

The addition of small amounts of niobium to low-carbon, 18Cr–8Ni stainless steel results in a substantial increase in yield strength. Weld efficiencies are greater than 100% and Huey tests indicate no serious sensitization. Nb additions also markedly strengthen a 17Cr–12Ni–2.5Mo steel, but stainless alloys containing 20 and 33% Ni are less responsive. (auth)

45911 A RESISTOMETRIC STUDY OF THE INITIAL AGING BEHAVIOR OF QUENCHED COPPER–BERYLLIUM ALLOYS. Lawley, A.; Lukens, K. F.; Kimura, H.; Maddin, R. (Univ. of Pennsylvania, Philadelphia). Amer. Soc. Metals, Trans. Quart., 60: 516-27(Sept. 1967).

A resistometric study has been made of the initial stages of aging in solution treated and quenched Cu–Be (3.5 to 12.5 at. % Be). Variation of the initial rate of increase of resistance with quenching temperature and temperature of aging, and the magnitude of the resistance change, is controlled by the quenched-in vacancy concentration, the extent of the vacancy-solute atom interaction, and the degree of solute clustering. The apparent energy of formation of vacancies in the alloy is lower than that in the pure solvent due to a solute-vacancy binding energy ~0.23 eV. Activation energies for the aging process are calculated and compared with that required for vacancy migration in pure Cu. The activation energy for diffusion of Be in Cu (~1.62 eV) is lower than that obtained from high temperature diffusion data (~1.81 eV). (auth)

45912 A FRACTOGRAPHIC INVESTIGATION OF THE EFFECT OF ENVIRONMENT ON FATIGUE-CRACK PROPAGATION IN AN ULTRAHIGH-STRENGTH STEEL. Spitzig, W. A.; Wei, R. P. (United States Steel Corp., Monroeville, Pa). Amer. Soc. Metals, Trans. Quart., 60: 279-88(Sept. 1967).

The influence of gaseous environment on the mode of fatigue fracture in quenched and tempered 0.45% C low-alloy ultrahigh-strength steel (tempered at 400 or at 800 F) has been investigated by fractographic analysis. The same rates of fatigue-crack growth were observed in a dry environment when the fracture mode was either predominantly dimple-rupture (800 F tempered material) or quasi-cleavage (400 F tempered material). The influence of water vapor on the fatigue-crack growth rate was not simply reflected by changes in fracture mode. Material tempered at 400 F exhibited an increase in crack-growth rate of approximately 50% in a humid environment, but no significant change was observed in fracture mode. Material tempered at 800 F showed only a 10% increase in crack-growth rate in a humid environment even though the fracture mode changed from predominantly dimple-rupture to intergranular. The results suggest that at the low stress levels used in this investigation (approximately $\frac{1}{10}$ of the yield strength), differences in the microscopic fracture behavior, as observed by fractographic analysis, do not correlate simply with gross crack-growth rates. (auth)

45913 ELEVATED-TEMPERATURE TENSILE DUCTILITY MINIMUM IN SILICIDE COATED Cb-10W AND Cb-10W-2.5Zr. Allen, B. C.; Bartlett, E. S. (Battelle Memorial Inst., Columbus, Ohio). Amer. Soc. Metals, Trans. Quart., 60: 295-304(Sept. 1967).

An investigation was made of factors affecting the tensile ductility minimum behavior of silicide-coated Nb alloys in air in the intermediate temperature range 700 to 1100°C. In the

case of Cr–Ti–Si-coated Nb–10W and Nb–10W–2.5Zr (Nb–725 Alloy) sheet, contamination and embrittlement by air at the base of coating cracks is the major factor responsible for loss of ductility. Apparent mechanical interaction between coating and substrate plays a smaller role but becomes more important with decreasing substrate thickness. The Ag–Al–Mo–Si liquid phase coating gives somewhat improved ductility above 750°C by filling cracks in the silicide phase. The presence of Zr, dynamic strengthening of the substrate, and thickening the subsilicide layer to 1 mil all have relatively little effect on ductility. (auth)

45914 NATURE OF BRITTLENESS OF MOLYBDENUM. Mal'tsev, M. V.; Shulepov, V. I. pp 125-30 of Fiz Priorda Khrupk Razrush Met. Kiev, Nauk Dumka, 1965. (In Russian).

Various theories that explain the brittleness of Mo at room and reduced temperatures are analyzed. Its brittleness is assumed connected with decomposition of the solid solution of interstitial impurities, which in cast Mo is mainly localized in the polygonal boundaries and in the volume of the grains in the dislocation pile-ups. (Rev. Met. Lit.)

45915 THERMAL EXPANSION OF SOLID SOLUTIONS OF REFRACTORY METALS OF THE IV, V, AND VI GROUPS IN THE PERIODIC TABLE. Pridantseva, K. S.; Solov'eva, N. A. pp 41-7 of Vysokotemperaturn Neorgan Soedineniya. Kiev, Nauk Dumka, 1965. (In Russian).

The coefficient of thermal expansion of single-phase solid solutions in binary systems of refractory metals of the IV–Vi groups in the periodic table up to 800 to 900°C was measured: Mo–Cr, Mo–Nb, Mo–V, Cr–V, Nb–V, Zr–Ti, Zr–Hf, Cr–Fe, and V–Fe. In all cases thermal expansion was almost linearly dependent on the composition (CrV, Cr–Mo, Mo–Nb, and Zr–Ti) or varied along a curve remaining within limits of thermal expansion values of the elements that form the system (Nb–V and Mo–V). The presence of Hf (0.03 to 0.65 and 1.1%) in the initial Zr had no effect on thermal expansion of Zr–Ti solid solutions. The nature of the change for magnetic Fe–Cr alloys differed: at a content of only 5%, thermal expansion dropped sharply from 13×10^{-6}/C, (for pure Fe) to 11.8×10^{-6}/C[6] at 20 to 300°C. At 45% Cr, thermal expansion has a maximum; however, at 50% Cr upwards, thermal expansion decreased monotonically in both the magnetic and paramagnetic regions. The maximum of thermal expansion corresponded to the presence of a single-phase sigma phase with a crystal structure and lattice constants (a = 8.800 and c = 4.544 Å), which differ sharply from the lattice constants of Fe and Cr. The picture is similar in the Fe–V system where a sigma phase is formed at 50% V after prolonged annealing at 1000°C. (Rev. Met. Lit.)

45916 MAGNETIC PROPERTIES OF RARE EARTH–IRON INTERMETALLIC COMPOUNDS. Strnat, K.; Hoffer, G.; Ray, A. E. IEEE (Inst. Elec. Electron. Eng.), Trans. Magnet., MAG-2: 489-93(Sept. 1966).

Curie points, the temperature dependence of the high-field magnetization below room temperature, saturation moments, and densities are reported for the most iron-rich compounds in the rare earth-iron systems. The heavy rare earth compounds have the composition A_2Fe_{14} and the hexagonal Th_2Ni_{17}-type structure, while the light rare earths have the stoichiometry AFe_7 and a modified rhombohedral Th_2Zn_{17} structure. From the saturation of Y_2Fe_{17} and Lu_2Fe_{17}, an iron moment of 2.0-Bohr magnetons/Fe atoms was calculated. In these two compounds and in $CeFe_7$, $PrFe_7$, and, perhaps, $NdFe_7$, all atomic moments couple ferromagnetically, while for Gd_2Fe_{17} through Tm_2Fe_{17} the magnetizations of the rate earth and iron sublattices subtract. Curie temperatures range from −180°C ($CeFe_7$) through a peak of 186°C (Gd_2Fe_{17}) to −41°C (Tm_2Fe_{17}). This suggests that two exchange mechanisms are active and make comparable contributions to the interaction energy: direct exchange between Fe atoms and indirect coupling via conduction electrons between iron and the rare earth atoms. (Rev. Met. Lit.)

45917 MAGNETOCRYSTALLINE ANISOTROPY OF YCo_5 AND Y_2Co_{17}. Hoffer, G.; Strnat, K. IEEE (Inst. Elec. Electron. Eng.), Trans. Magnet., MAG-2: 487-9(Sept. 1966).

The magnetocrystalline anisotropy constants K_1 and K_2 of two ferromagnetic intermetallic compounds, YCo_5 and Y_2Co_{17}, were measured at room temperature. YCo_5 has a magnetically easy c axis and $K_1 = 5.7 \times 10^7$ erg/cm^3; K_2 was not determined but was estimated to be less than 10^6 erg/cm^3. Y_2Co_{17} has an easy basal plane, and, by three different methods of measurement: $K_1 + K_2 = -3.0 \times 10^6$ erg/cm^3; $K_1 = -2.9 \times 10^6$ erg/cm^3, $K_2 = 0.03 \times 10^6$ erg/cm^3; $K_1 = -2.1 \times 10^6$ erg/cm^3, $K_2 = -0.1 \times 10^6$ erg/cm^3. (Rev. Met. Lit.)

45918 EFFECT OF ALLOYING ON THE ELASTIC MODULUS, STRENGTH AND PLASTICITY OF TITANIUM AT -196 TO 800 C. Kovtun, S. F.; Ul'yanov, R. A. pp 180-8 of Novye Issled Titan Splavov. Moscow, Nauka, 1965. (In Russian).

Al, Cr, Mo, Re, and Pd introduced within the limits of solubility in alpha-Ti increased the elastic modulus. At concentrations of Cr, Re, Mo, and Pd that are higher than the solubility limit, the elastic modulus of the alloy is lower than that of pure Ti. Up to 3% Re increased the tensile strength at room and high temperatures, but drastically reduced elongation. Pd and Ta had an insignificant influence on tensile strength and elongation. La had an insignificant influence on the elastic modulus and tensile strength, but increased elongation at low temperatures. Up to 1% Ir, Bi, Se, In, and Be reduced elongation at low temperatures. (Rev. Met. Lit.)

45919 EFFECT OF MEDIUM AND ANNEALING TEMPERATURE ON PROPERTIES OF MOLYBDENUM. Khoroshailov, V. G.; Bogoyavlenskii, K. N.; Rossomakho, Ya. V. Tr. Leningrad. Politekh. Inst., No. 251, 28-30(1965). (In Russian).

The best conditions for heat treatment of Mo prepared by powder metallurgy were determined. Mo strip 0.2 mm thick and 99.9% pure was vacuum annealed in an atmosphere of H_2 at 800 to 1400°C for 45 min. The metal recrystallized at 1100°C. Elongation increased from 4 to 16% and the tensile strength and Vickers hardness decreased. At 1200 to 1400°C a cumulative recrystallization occurred. An increase in the holding time above 45 min at a given annealing temperature had no substantial effect on the properties of Mo. The temperature of the beginning of recrystallization during vacuum annealing was 100 to 150°C higher than during annealing in H_2. This is connected with air leaking into the ampoule. When the selected processing techniques are used, the contamination of Mo is higher than during annealing in an atmosphere of H_2. (Rev. Met. Lit.)

45920 STRENGTH OF TUNGSTEN MICROCRYSTALS. Garber, R. I.; Dranova, Zh. I.; Mikhailovskii, I. M. (Physical-Technical Inst., Kharkov). Dokl. Akad. Nauk SSSR, 174: 1044-7 (June 11, 1967). (In Russian).

Dependence of the strength of tungsten microcrystals at 77°K on their size was investigated. The stresses in the surface of microcrystals were determined from the magnitude of the ponderomotive forces generated by an electric field, using the equation $\sigma = E^2/8\pi$, where E = intensity of the electric field near the specimen's surface and σ = stress. Specimens were prepared from 99.9%-pure tungsten wire 0.05 to 0.15 mm in diameter by electrochemical polishing, which produced needles with a tip 100 to 1200 Å in diameter, consisting of single crystals in most cases. It was found that the strength of the crystals was 2100 ± 100 kg/mm^2 and was almost independent from the crystal diameter in a range of 200 to 1200 Å. (ATD)

45921 PROPERTIES OF SINTERED W–Mo–Re ALLOYS. Milner, A.; Rowenhorst, D. D.; Bergstrom, T. R. (3M Company Central Research Labs., St. Paul). J. Less-Common Metals, 13: 488-92(Nov. 1967).

Tensile property data on unwrought W–30Mo–30Re rod prepared by direct conversion of elemental powders are presented. Small-diameter tubing of this material is shown to be capable of 35% reduction of area in cold drawing and 68% in warm drawing without prior mechanical or thermal treatment. (auth)

45922 BEND YIELD STRESSES IN TUNGSTEN SHEET. Farrell, K.; Schaffhauser, A. C.; Stiegler, J. O. (Oak Ridge National Lab., Tenn.). J. Less-Common Metals, 13: 548-58 (Nov. 1967).

Recrystallized W sheet tested in bending at temperatures just above the ductile-brittle transition temperature displays marked discontinuities on the load-deflection curve. These discontinuities bear a striking resemblance to yield point inflections. Their temperature dependences are the same as those reported for tensile yield stresses in W. They also show a strong dependence on grain size on a Hall–Petch type plot. However, better relationships are obtained by using an exponent other than $-\frac{1}{2}$ or by breaking the $d^{-\frac{1}{2}}$ curve into segments corresponding to different parts of the grain size-annealing temperature curve. This suggests that the annealing treatment contributes to the grain size dependence of the bend yield stresses. (auth)

45923 DETERMINATION OF THE ANISOTROPY OF YIELDING AND FLOW IN ZIRCALOY-2 FROM A SINGLE TEST. Rittenhouse, P. L. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. J. Nucl. Mater., 23: 183-91(1967). (ORNL-P-2944).

Experimental yield and strain data on Zircaloy-2 with varied crystallographic texture were used to develop empirical correla-

tions that relate yield strength and strain behavior parameters. These correlations allow the calculation of tension and compression yield strengths and strain anisotropy constants for the principal fabrication directions from the data obtained in a single test. The correlations are also felt to be valuable for material specification, quality control, and internal consistency checks on experimental data. (auth)

45924 INFLUENCE OF ZIRCONIUM ON DYNAMIC STRENGTHENING OF NIOBIUM ALLOYS. Wilcox, B. A.; Allen, B. C. (Battelle Memorial Inst., Columbus, Ohio). J. Less-Common Metals, 13: 186-92(Aug. 1967).

Tensile and creep tests on Nb–10W and Nb–10W–2.5 Zr. alloys show that the addition of Zr causes the dynamic strengthening temperature range to be increased from ~200° to 500°C to ~650° to 1000°C. This finding is in accord with previous data in the literature which show that a 1% Zr addition to unalloyed Nb causes a similar effect. Possible mechanisms for this effect of Zr are discussed, and it is tentatively concluded that inhibition of recovery by precipitation during deformation plays an important role. (auth)

45925 MECHANISM OF DIFFUSION IN bcc TRANSITION METALS. Peart, R. F. (Watson Research Lab., Yorktown Heights, N. Y.); Askill, J. Phys. Status Solidi, 23: 263-75 (Sept. 1, 1967).

A simple divacancy–vacancy analysis has been applied to diffusion data in bcc transition metals. Consideration of the divacancy contribution at high temperatures to diffusion coefficients determined with radioactive tracers is shown to be consistent with the nonlinear Arrhenius relationships for diffusion in V, Cr, β Ti, and β Zr and with the corresponding linear relationships obtained for other bcc metals. (auth)

45926 TRACER DIFFUSION OF TUNGSTEN IN MOLYBDENUM. Askill, J. (Millikin Univ., Decatur, Ill.). Phys. Status Solidi, 23: K21-3(Sept. 1, 1967).

Diffusion measurements were made at 2075, 2180, and 2260°C using ^{185}W as tracer. The values of the diffusion coefficients were found to be 1.0×10^{-10} cm^2/sec at 2075°C, 3.11×10^{-10} cm^2/sec at 2180°C, and 4.07×10^{-10} and 4.67×10^{-10} cm^2/sec at 2260°C. The values obtained for the parameters D_0 and Q were 1.7 cm^2/sec and 110 kcal/mole, respectively. (A.G.W.)

45927 STUDIES ON PROPERTIES OF SOME TERNARY COPPER ALLOYS OF THE Cu–Mn–Zn AND Cu–Mn–Ni SYSTEM. Lahiri, A. K.; Mukherjee, K. P.; Banerjee, T. (National Metallurgical Lab., Jamshedpur, India). Trans. Indian Inst. Metals, 19: 141-6(Sept. 1966).

Some of the important properties of ternary Cu alloys containing 55 to 80% Cu, 8 to 25% Mn and 8 to 25% Zn or 5 to 8% Ni are presented. Studies on the mechanical properties indicated that addition of Zn has a beneficial effect in increasing the ductility and deep drawing properties of ternary alloy though there was some decrease in strength and hardness. Addition of Ni, on the other hand, increased the strength and hardness without any marked effect on ductility and deep drawing properties. Addition of Zn or Ni was found to increase corrosion resistance properties of Cu-Mn alloys. (auth)

45928 DENSITY STUDIES OF LIQUID METAL SYSTEMS. Faxon, Robert C. Syracuse, N. Y., Syracuse Univ., 1966. 160p.

Thesis.

Eight binary metallic systems have been studied in the liquid state by means of density analysis to determine if a measure of "bonding" could be detected at stoichiometries corresponding to known compounds. Of the eight systems, Bi–Te, Mg–Sn, Mg–Pb, Mg–Bi, Tl–Se, Hg–Tl, Na–Li, and Cd–Sb, three did not indicate bonding by these density studies. The three were the Mg–Pb, Na–Li and Cd–Sb systems. Each of the eight systems has been discussed individually. A reliable and relatively simple method for determining immiscibility boundaries in binary systems (metallic systems in particular) by means of density investigation, has been developed and discussed. The method has been compared to the formerly used methods of chemical analysis, quenching, opalescence and thermal analysis. Immiscibility regions in the Na–Li and Tl–Se systems as well as several organic systems were determined in this manner. (auth) (Disser. Abstr.)

Structure and Phase Studies

45929 (BNWL-546) HEAT TREATMENT OF THE ALLOY Zr–2.5 WT PERCENT Nb. Michaels, T. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1967. Contract AT(45-1)-1830. 20p. Dep. CFSTI.

Heat treatment effects on Zr–2.5 wt % Nb are described. Five areas were studied qualitatively: microconstituent survey, recrystallization, isothermal transformation characteristics, aging characteristics, and tensile properties as a function of solution heat treatment temperature. (auth)

45930 (COO-1431-3) EFFECT OF ANNEALING ON THE SUBSTRUCTURE OF COLD WORKED fcc METALS AND ALLOYS. Technical Progress Report No. 3, September 1, 1966–September 1, 1967. Mikkola, D. E.; Kirby, J. W.; Ward, A. L. (Michigan Technological Univ., Houghton. Dept. of Metallurgical Engineering). Contract AT(11-1)-1431. 33p. Dep. CFSTI.

The annealing behavior of α-Cu-Ge solid solutions and the ordered alloy Cu_3Au is examined to relate the changes in substructure of cold worked fcc metals and alloys to physical properties. X-ray line broadening and peak shifts are used to examine the substructure of the alloys. (H.D.R.)

45931 (IS-T-189) DIFFUSION OF CARBON, NITROGEN, AND OXYGEN IN BETA THORIUM. Carnahan, Thomas George (Ames Lab., Iowa). Aug. 1967. Contract W-7405-eng-82. 36p. Dep. CFSTI.

Thesis.

The diffusion coefficients of C, N_2, and O_2 were determined in β Th over the temperature range 1435 to 1715°C. Beta Th has the body centered cubic structure. Values for the activation energies were found to be 27 ± 3 kcal/mole for C, 17 ± 4 kcal/mole for N_2, and 11 ± 4 kcal/mole for O_2 diffusion. The frequency factors, D_0, were found to be 0.02 ± 0.01 cm^2/sec for C, 0.003 ± 0.002 cm^2/sec for N_2, and 0.001 ± 0.003 cm^2/sec for O_2 diffusion. The experimental method was a diffusion couple technique. Also, C was found to harden annealed Th nearly linearly with concentration over the range 100 to 1000 ppM C. (auth)

45932 (IS-T-192) ON THE ELECTRICAL RESISTIVITY AND THE $\beta \rightarrow \alpha$ TRANSFORMATION OF LANTHANUM. Omohundro, John Edward (Ames Lab., Iowa). Aug. 1967. Contract W-7405-eng-82. 76p. Dep. CFSTI.

Thesis.

The temperature dependence of the electrical resistivity of La metal has been determined for the temperature range from 85°K to 975°K. A resistive hysteresis in the temperature range of 200°C to 300°C has been observed and has been associated with an allotropic transformation. Time based isothermal studies of the electrical resistance of La specimens quenched from 350°C have been made which indicate that the transformation occurs in two stages. Activation energies are 380 cal/gram-atom for the first stage but could not be determined for the second stage from the data obtained in this work. The transition between stages has been associated with the depletion of sites for the ready formation of nuclei. Transmission electron microscopy has been employed to examine the microstructure and the thermal behavior of La over the temperature range of –150°C to 320°C, and the continuation of the transformation to the α or low temperature form has been observed to be suppressed to as far as –150°C in thin foils. Apparent discrepancies in this work and conflicts with work reported in the literature have been qualitatively explained, in part, based on a point defect elimination mechanism. (auth)

45933 (RPI-3004-5) DENDRITE GROWTH IN SUPERCOOLED METALS. Final Report. Childs, Wylie J.; Schneider, E. J.; Rudaw, Peter S.; Mushovic, John N. (Rensselaer Polytechnic Inst., Troy, N. Y.). Aug. 1967. Contract AT(30-1)-3004. 63p. Dep. CFSTI.

Three different aspects of dendrite growth investigations are presented in separate sections. Results and discussions are presented for experimental and theoretical studies on (1) the velocity of dendrite growth in Bi and several Bi alloys, (2) crystal growth and morphology in supercooled Bi–Cd and Bi–Sb alloys, and (3) the effect of supercooling on the dendrite morphology of Ni. (H.D.R.)

45934 (IS-Trans-71) THEORY OF PRISMATIC CROSS-SLIP OF DISLOCATIONS IN THE VICINITY OF PRECIPITATIONS. Gleiter, H. Translated by S. J. Rimshaw for Ames Lab., Iowa, from Acta Met., 15: 1213-21(July 1967). 15p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

A new mechanism of prismatic cross-slip is theoretically deduced. It is shown that the Orowan process for coherent strained precipitations is not, as previously assumed, a complete bypass mechanism, but rather it represents the first stage of prismatic cross-slip. (auth)

45935 (IS-Trans-72) EXPERIMENTAL STUDIES OF PRISMATIC CROSS-SLIP OF DISLOCATIONS IN THE VICINITY OF COHERENT STRAINED PRECIPITATIONS. Gleiter, H. Translated by S. J. Rimshaw (Ames Lab., Iowa), from Acta Met., 15: 1223-8(July 1967). 9p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

The experimental research which was carried out to test the proposed Cu–Co (3.12 at. % Co) and Ni–Si (12 at. % Si) alloy mechanism is presented. These alloys contained spherical coherent precipitations with a radially-symmetrical deformation field, and they were therefore suitable for testing the theory for movement of dislocations. (auth)

45936 STUDY OF THE URANIUM–HYDROGEN SYSTEM AT HIGH PRESSURE. Chevallier, J.; Desre, P.; Spitz, J. (CEN, Grenoble, France). J. Nucl. Mater., 23: 289-301(1967). (In French).

The system U–H_2 was investigated for pressure-temperature-concentration equilibria up to 150 atm and 860°C. The H_2 solubility in U and the hydride hypo-stoichiometry increase with temperature. At 820°C and about 83 atm, the compositions of the solid solution ⟨U, H⟩ and of the hydride UH_{3-x} become equal. Above this temperature, the system forms only a continuous solid solution. The equilibrium diagram U–UH_3 for the three variables pressure-temperature-concentration has been established from these results. The hydride loses its pyrophoric character when cooled in hydrogen. The partial and total thermodynamic quantities related to the solid solution ⟨U, H⟩ and to the hydride UH_{3-x} are computed as functions of composition at various temperatures. (auth)

45937 PHASE DIAGRAMS. PART 2. Livey, D. T.; Feschotte, P. pp 53-72 of Plutonium: Physico-Chemical Properties of its Compounds and Alloys. Vol. 4, Special Issue No. 1. New York, National Agency for International Publications, Inc., 1966.

Phase diagrams were investigated at room temperature and high temperatures for the following systems: alkali metals and alkaline earth metals with Pu and Al–Pu, B–Pu, Be–Pu, C–Pu, Ce–Pu, Cr–Pu, Fe–Pu, Hf–Pu, Mo–Pu, N–Pu, Nb–Pu, Ni–Pu, Np–Pu, O–Pu, Os–Pu, Ru–Pu, Sn–Pu, Ta–Pu, Th–Pu, Ti–Pu, U–Pu, V–Pu, W–Pu, Zn–Pu, and Zr–Pu. The phase diagrams for the O–Pu system are shown from 0 to 61.69% oxygen and from 61.69 to 66.67% oxygen. Data for phase compositions, phase boundaries, crystal structure, lattice spacing, and transformation mechanisms are given where known. (Rev. Met. Lit.)

45938 EQUILIBRIUM STUDIES ON THE SYSTEMS $ZrCr_2$–H_2, ZrV_2–H_2, AND $ZrMo_2$–H_2 BETWEEN 0° AND 900°C. Pebler, A.; Gulbransen, E. A. (Westinghouse Research Labs., Pittsburgh). Contract AT(30-1)-3203. Trans. Met. Soc. AIME, 239: 1593-1600(Oct. 1967). (WERL–3203-8).

Pressure-composition isotherms have been determined for the systems $ZrCr_2$–H_2, ZrV_2–H_2, and $ZrMo_2$–H_2 between 0° and 900°C at H_2 pressures between 10^{-4} and 760 torr. These studies plus X-ray diffraction analyses of selected compositions show that these intermetallic compounds form a complete series of H_2 solid solutions within this temperature and pressure range. The partial molar enthalpies and entropies of solution of H_2 in the three intermetallic compounds were calculated. The solubility of H_2 in these Laves phases can be related to their free electron concentration. (auth)

45939 NUCLEATION AND GROWTH OF MARTENSITE IN SOME URANIUM–CHROMIUM ALLOYS. Bar-Or, A.; Kimmel, G. (Israel Atomic Energy Commission, Tel Aviv). Trans. Met. Soc. AIME, 239: 1615-19(Oct. 1967).

The rate of nucleation and the rates of both lateral and longitudinal growth of martensite plates (needles) in $\beta \rightarrow \alpha$ transformation were determined as a function of temperature, in various U–Cr alloys. The activation energies for nucleation and both modes of growth were calculated from the experimental results. The identical values for lateral and longitudinal growth clearly indicate that both are controlled by the same mechanism. Lomer's suggestion that single-atom movement over subatomic distances controls the specially slow growth of martensite receives further support from the present kinetic study, which shows that the growth rate can be described quantitatively by known formulas for the growth rate in processes involving single-atom movement. (auth)

45940 FIBER TEXTURE IN DRAWN TUNGSTEN WIRES. Nakajima, S.; Okazaki, H. (Matsushita Electronics Corp., Osaka). Trans. Met. Soc. AIME, 239: 1060-65(July 1967).

Quantitative studies of the deformation texture in drawn W wires were made by the X-ray diffractometer. Experimental results show that the diffraction intensities are equal to those predicted from the ⟨110⟩ fiber texture but the angular spreads of diffraction peaks in the pole distribution curves are different for different diffraction planes and directions. For this reason a modified ⟨110⟩ f fiber texture model, in which a kind of anisotropy is assumed, is proposed to explain the results. According to this model the poles lying on a line directing from the $(1\bar{1}0)$ to the $(\bar{1}10)$ poles in the (110) standard stereographic projection should show spreads which are different from those lying on a line directing from the (001) to the $(00\bar{1})$ poles, which is confirmed by the experiments. The anisotropy and the spreads of the pole positions are large at the outer part of the wires and decrease gradually towards the inside of the wire. The possibility of occurrence of such anisotropy in metals with fcc structures is discussed. (auth)

45941 METALLOGRAPHIC TECHNIQUE FOR POLISHING AND ETCHING BERYLLIUM. Wheeler, G. A.; Price, C. W. (Battelle Memorial Inst., Columbus, Ohio). Trans. Met. Soc. AIME, 239: 1657-59(Oct. 1967).

An electrolytic polishing technique for Be that can also provide an excellent bright-field etch is described. In addition to the bright-field etch, other advantages of this technique are excellent reproducibility, rapidity, and ease of polishing and etching. (auth)

45942 THERMALLY ACTIVATED DEFORMATION OF ALPHA ZIRCONIUM. Ramaswami, B.; Craig, G. B. (Univ. of Toronto). Trans. Met. Soc. AIME, 239: 1226-31(Aug. 1967).

The temperature and strain rate dependence of the flow stress ratio and the strain rate dependence of the flow stress of annealed polycrystalline α Zr were determined over the temperature range 300 to 1000°K. Some evidence was found for strain aging and discontinuous flow in the temperature ranges 520 to 650°K and 650 to 760°K, respectively. The Cottrell-Stokes relationship was obtained when deformation occurred by twinning as well as slip. The flow stress ratio showed a strong dependence on temperature and strain rate above 800°K. The experimental evidence indicated that the rate-controlling mechanism for the deformation of α Zr above 800°K was dislocation climb, and that the deformation was not thermally activated in the range 520 to 800°K. The stacking-fault energy of α Zr was estimated to be about 250 ergs per sq cm. (auth)

45943 TEXTURE DEVELOPMENT AND CRYSTAL PERFECTION IN NIOBIUM (COLUMBIUM) ANNEALED AT 2000°C. Sandelin, J. W.; Birks, L. S. (Naval Research Lab., Washington, D. C.). Trans. Met. Soc. AIME, 239: 1269-70(Aug. 1967).

Niobium shows cold-rolled textures of {100}⟨011⟩ and {112} ⟨011⟩ with a preference for the {100}. When Nb has been annealed up to 2000°C, nearly 70% of the grains showed {111} texture with only a weak {112} component and an insignificant {100} component remaining. In addition, double-crystal rocking curves were used to follow the increase in crystal perfection of the grains with increased annealing time. (auth)

45944 HIGH-ANGLE SUBSTRUCTURE IN ELECTRON-BEAM ZONE-MELTED TUNGSTEN. Hay, D. R.; Scala, E. (Cornell Univ., Ithaca, N. Y.). Trans. Met. Soc. AIME, 239: 1272-73(Aug. 1967).

The mechanical properties of W are sensitive to the nature of the intergranular structure. Substructure and dislocation networks in single-crystal and polycrystalline W have been studied. Various orders of substructure were observed ranging from a microscopic first order (2 to 8 mm) to a microscopic second order (50 to 300 μ), and, within the latter, dislocation networks forming an even smaller order of substructure. In their single crystals, grown by arc fusion, the degree of misorientation in each order was small: 16′30″, ~1′, and ~10″ for the first-, second-, and third-order substructure respectively. (auth)

45945 IRON–TANTALIUM SYSTEM. Sinha, A. K.; Hume-Rothery, W. (Univ. of Oxford). J. Iron Steel Inst. (London), 205: 671-3(June 1967).

The Fe–Ta system was studied in the range 0 to 15 at. % Ta, using thermal analysis, microscopical metallography, and dilatometry. The diagram is of the contracted γ-field type, and involves a eutectic reaction between the δ-solid solution and an intermediate phase based upon Fe_2Ta, which is a $MgZn_2$-type Laves phase. The eutectic reaction temperature is 1440°C, the compositions of the liquid and the solid δ-phase at this temperature being 7.9 at. % Ta and 2.8 at. % Ta, respectively. At 1239°C, the δ-phase (1.1 at. % Ta) decomposes eutectoidally into γ-phase (0.5 at. % Ta), and Fe_2Ta. The γ-phase (0.3 at. % Ta) and Fe_2Ta give rise to a peritectoid reaction at 972°C, resulting in the formation of the α-phase (0.6 at. % Ta). The Fe-rich liquidus–solidus relationships were considered in the light of the Van't Hoff's equation, and the free-energy change involved, which can be resolved into two components, the melting point effect, and the lattice distortion effect. The present diagram is compared with that drawn by Hansen. (auth)

45946 TRANSFORMATION STRUCTURE OF ALLOY U-1.5 W/O Mo BY RAPID COOLING STARTING WITH γ PHASE. Sifferlen, R.; Guillaumin, J.; Saulnier, A. (Societe Industrielle de Combustible Nucleaire, Veurey-Voroize, France). J. Nucl. Mater., 23: 270-9(1967). (In French).

A thermal analysis study has been made of the behavior of U-1.5 wt % Mo alloy during rapid cooling from the γ phase. The re-

sultant structures were identified by optical microscopy and thin film electron microscopy. In order of diminishing cooling rate, we distinguish "martensitic," submicroscopic "Widmanstätten" and "basket-weave" structures. The first two structure types are hard and brittle. Apart from these, a "pearlitic" reaction takes place during cooling in the neighborhood of grade boundaries and carbide inclusions. These various structures can exist side by side in one sample. We have pin-pointed the conditions for their appearance in terms of the cooling-rate, which itself determines the temperature at which each reaction sets in. (auth)

45947 DIFFUSION OF METALLIC FISSION PRODUCTS IN PYROLYTIC CARBON. Gethard, P. E.; Zumwalt, L. R. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nucl. Appl., 3: 679-85(Nov. 1967).

The diffusion of Sr and Cs through thin layers (100 μm) of isotropic pyrolytic C has been measured over the temperature range 1000 to 1700°C. Diffusion coefficients observed for Cs are orders of magnitude lower than those for Sr. The diffusion rates for both series are much lower than those observed in porous polycrystalline graphite, where little difference is seen between Cs and Sr. When constant chemical potential sources are used, chemical- and self-diffusion measurements for Sr give identical results in the Sr concentration range 0.01 to 0.2 wt %. There is apparently no concentration effect for Cs over the range 1.0×10^{-5} to 0.15 wt %. The difference between Sr and Cs diffusion in pyrolytic C is attributed to the greater steric effect of the pyrolytic-C defect structure relative to Cs. (auth)

45948 CONTRIBUTION OF THE STUDY OF THE PLUTONIUM–ZIRCONIUM PHASE DIAGRAM. Lauthier, J. C.; Housseau, N.; Van Craeynest, A.; Calais, D. (CEN, Fontenay-aux-Roses, France). J. Nucl. Mater., 23: 313-19(1967). (In French).

The intermetallic compound $PuZr_2$ can be synthesized from the elements only in the presence of oxygen, which considerably accelerates diffusion. At 615°C a peritectoid reaction takes place: PuZr (ϵ, bcc) + ZrPu (α hex.) $\rightleftharpoons$ $PuZr_2$ (θ, fcc). (auth)

45949 THE CRITICAL RECRYSTALLIZATION STRAIN OF Pu-1 WT PERCENT Ga. Beer, B. J.; Pavlick, J. E. (Dow Chemical Co., Golden, Colo.). Contract AT(29-1)-1106. J. Nucl. Mater., 23: 236-7(1967).

The critical strain of electrorefined Pu alloyed in vacuum at 950°C with 1 wt % Ga was determined at 375 and 450°C for specimens strained at room temperature in tension, and the recrystallization temperature was determined for specimens deformed by rolling 20, 40, 60, 80, and 95%. The annealed and recrystallized grain sizes are presented. (H.D.R.)

45950 THE PLUTONIUM $\beta \rightarrow \alpha$ TTT CURVE. Nelson, R. D. (Battelle Memorial Inst., Richland, Wash.). Contract AT(45-1)-1830. J. Nucl. Mater., 23: 238-40(1967). (BNWL-SA-1190).

The published $\beta \rightarrow \alpha$ time-temperature-transformation (TTT) curves are discussed, and a curve obtained by using the same quenching medium at all temperatures and by measuring the electrical resistivity of electrorefined Pu specimens 0.15 to 0.30 mm thick is presented. There thin specimens were measured by this technique to determine if the TTT curve is a simple "C" curve or if the curve contains a discontinuity in its slope. (H.D.R.)

45951 TERNARY PERITECTICS BETWEEN TUNGSTEN, MOLYBDENUM, AND URANIUM MONOCARBIDE. Chubb, W. (Battelle Memorial Inst., Columbus, Ohio). J. Nucl. Mater., 23: 336-40(1967).

Peritectic reactions in the ternary U–C–Mo and U–C–W systems were studied. High-purity specimens of the alloys were subjected to various heat treatments and the phases were identified by metallographic methods, hardness measurements, and x-ray diffraction techniques. Structures for the alloys showing the $UMoC_2$ and UWC_2 phases formed and phase diagrams for the two alloy systems are presented. (H.D.R.)

45952 INTERDIFFUSION BETWEEN COMPONENTS AND THE PHASE DIAGRAM OF THE Ti–W SYSTEM. Shinyaev, A. Ya.; Sokiryanskii, L. F.; Ditsman, S. A.; Kupriyanova, T. A. pp 43-7 of Novye Issled Titan Splavov. Moscow, Nauka, 1965. (In Russian).

The interdiffusion of Ti and W was investigated at 1000 to 1600°C. The diffusion zone was analyzed by attenuation of a 10 to 15 μ beam of gamma rays from ^{127}Te. The change in concentration of Ti in the diffusion zone is indicative of the existence of a two-phase region in the Ti–W system in the given temperature region. The change in the concentration of the components in the diffusion zone with the depth was measured by an x-ray microanalyzer. The limit of solubility of Ti in W was from 7 to 10%. The coefficients of interdiffusion of Ti with W and Mo at concentrations up to 10 at. % W and Mo were calculated by Hall's analytical method. The diffusion coefficient of W was considerably higher than that of Mo. The difference in the diffusion properties and in the phase diagram type of the Ti–W and Ti–Mo systems was assumed due to the large difference in the interatomic binding force in W and Mo. (Rev. Met. Lit.)

45953 NATURE OF CREEP CAVITIES IN TUNGSTEN. Stiegler, J. O.; Farrell, K.; Loh, B. T. M.; McCoy, H. E. (Oak Ridge National Lab., Tenn.). Amer. Soc. Metals, Trans. Quart., 60: 494-503(Sept. 1967).

An electron fractographic technique has been used to study grain-boundary cavities formed in tungsten under creep conditions. The appearance of the cavities depends strongly on the conditions of temperature and stress. At lower temperatures and higher stresses, the cavities are shallow and irregularly shaped; they have blunt ends and are best described as being ameoboid. Under lower stresses and higher temperature, they acquire regular, polyhedral shapes. The different structures are rationalized by considering the competition between growth by slip, grain-boundary sliding or stress-induced vacancy diffusion and internal rearrangement by surface diffusion. Triple grain junctions are not preferred sites of cavity nucleation although a few occur at them. Conflicts between these observations and previous ones made by optical microscopy are resolved, and possible nucleation mechanisms that are compatible with the observations are discussed. (auth)

45954 MORPHOLOGIES OF BUBBLES AND VOIDS IN TUNGSTEN. Farrell, K.; Loh, T. M.; Stiegler, J. O. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Amer. Soc. Metals, Trans. Quart., 60: 485-93(Sept. 1967). (ORNL-P-3088).

The shapes of grain boundary gas bubbles and creep voids in W have been studied by stereo electron fractography. Bubbles and voids are polyhedral, being bounded by {100}, {110}, {112} and {102} faces. In the bubbles the {100} and {112} faces are smooth but terraced, the {102} faces are stepped, and the {110} faces are rough. The {102} faces are thought to be composites of two {112} faces. Terracing is caused by growth of {112} faces. No terracing, stepping or roughness is observed on creep cavities. Relative surface tensions measured on small bubbles are approximately $\gamma\{100\} : \gamma\{112\} : \gamma\{110\} = 1.00 : 1.05 : 1.08$. The discrepancies between these values and the predictions of theoretical models may be due to adsorption of the unidentified gas phase in the bubbles. Other features of the bubbles can be explained by considering the kinetic processes involved in changing the size and shape of the bubbles and by postulating that the {110} faces are not real crystallographic planes for the conditions existing in the bubbles. (auth)

45955 HALL EFFECT OF MOLYBDENUM AND MOLYBDENUM-RICH MOLYBDENUM–IRON ALLOYS AT LIQUID N_2 AND ROOM TEMPERATURES. Shabel, B. S. (Syracuse Univ., N. Y.); Sarup, R.; Schroeder, K. J. Less-Common Metals, 13: 483-7 (Nov. 1967).

The Hall coefficient, R_H, of Mo–Fe alloys with up to 15 at. % Fe was measured at room temperature at 7 kOe and at liquid N_2 and liquid He temperatures in fields up to 100 kOe. R_H was, within experimental accuracy, independent of the applied field. R_H was always positive and reached its highest value of 34×10^{-13} volt-cm/amp-Oe at liquid He temperatures for an alloy with 1 at. % iron. At liquid N_2 temperatures, the maximum occurred at 2 at. % iron and at room temperature at 5 at. % Fe. (auth)

45956 ELECTROTRANSPORT OF CARBON, NITROGEN, AND OXYGEN IN VANADIUM. Schmidt, F. A.; Warner, J. C. (Iowa State Univ., Ames). J. Less-Common Metals, 13: 493-500(Nov. 1967).

The electrotransport velocities of carbon, nitrogen and oxygen in V were determined at 1650, 1735, and 1825°C. All three solutes were found to migrate in the opposite direction from the electron flow. Diffusion coefficients and effective charges were calculated for these elements at the same temperatures. The electric mobility of nitrogen was shown to be independent of the electric field. The specific resistivity of vanadium was also determined between 950 and 1830°C. (auth)

45957 THE AGE-HARDENING CHARACTERISTICS OF NIOBIUM-BASE ZIRCONIUM ALLOYS. Lundin, C. E.; Cox, R. R. (Univ. of Denver). J. Less-Common Metals, 13: 501-10(Nov. 1967).

The age-hardening characteristics of Nb-base, Zr alloys were investigated over the composition range 10 to 21 wt % Zr. Alloys were solution treated in the single-phase, Nb-solid-solution region, quenched, then aged in the Nb solid solution plus α-Zr region at the isothermal temperature levels of 450, 500, 550, and 600°C. Aging times varied from 1 to 5000 h. Hardness, resistivity, and tensile data provided the means of evaluating the structural effects. Optical metallography, electron microscopy, and

x-ray diffraction were used to study the various stages of precipitation. All of the alloys exhibited a very sluggish increase in hardness. The increase appeared earlier, and was more pronounced, with increasing aging temperature. The optimum hardness appeared beyond 10 h in all cases. The 17, 18, and 21 wt % Zr alloys aged at 500°C had the largest hardness increases. The overall hardening is attributed to solid solution hardening, dispersion hardening due to ZrO_2 and aging due to the precipitation of α-Zr. (auth)

45958 STUDIES OF PSEUDO-BINARY LAVES PHASE SYSTEMS CONTAINING LANTHANIDES. II. CONSTITUTION AND MAGNETIC PROPERTIES OF $PrAl_2$-BASE SYSTEMS CONTAINING Mn, Fe, Co, Ni, Cu, AND Ag. Oesterreicher, H.; Wallace, W. E. (Univ. of Pittsburgh). J. Less-Common Metals, 13: 475-82(Nov. 1967).

Crystal structures and magnetic behavior have been established for the pseudo-binary systems $PrAl_x$–x mole % $PrCo_2$ with x ranging from 0 to 100 and $PrAl_2$–15 mole % PrT_2 in which T = Mn, Fe, Co, Ni, Cu and Ag. The phase boundary of the terminal phase based on $PrCo_2$ occurs at 8 mole % $PrAl_2$, about one third that in the corresponding Gd and Er systems. Since the phase boundary is associated with Fermi Surface interactions with the 220 Brillouin Zone boundaries, the results imply a higher valence state for Pr than +3. Detailed estimates indicate that 24% of the Pr is in the quadripositive state. The Pr–Co–Al system differs from the Ln–Co–Al with Ln = Gd or Er in that no C14 intermediate phase develops. One or more intermediate structures develop in Pr–Co–Al but their structure is yet to be established. The more complex behavior in this case, and also the strong negative deviations from Vegard's rule in the $PrCo_2$ terminal phase, appears to stem from the variable Pr valency. The terminal solubility of $PrCo_2$ in $PrAl_2$ is 21 mole %. Ferromagnetic coupling in $PrAl_2$ changes to antiferromagnetic in all cases when 15 mole % of PrT_2 is dissolved in it with T = Fe, Co, Ni, Cu and Ag. $PrAl_{1.7}Mn_{0.3}$ is ferrimagnetic. The ordering temperatures observed at 19 kOe range from 6 to 26°K. Analysis of the magnetic results for $PrAl_{1.7}Mn_{0.3}$ indicates that Mn has a localized moment corresponding to four unpaired electrons, suggesting Mn exists as a triply charged cation in this alloy. (auth)

45959 RECRYSTALLIZATION, GRAIN GROWTH, AND THE DUCTILE–BRITTLE TRANSITION IN TUNGSTEN SHEET. Farrell, K.; Schaffhauser, A. C.; Stiegler, J. O. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. J. Less-Common Metals, 13: 141-55(Aug. 1967). (ORNL-P-2760).

The ductile-brittle transition temperature (DBTT) in bending has been examined in wrought and in recrystallized powder metallurgy W sheet as a function of annealing treatment and grain size. Wrought-and-recovered sheet consisting of small subgrains had the lowest DBTT of 70°C, but this was raised to 225°C by the onset of primary recrystallization at 1150°C. Primary grain growth was inhibited at annealing temperatures between 1300 and 2200°C. Secondary recrystallization started at 2000°C from one surface and the new grains grew readily. All recrystallized specimens had DBTT's in the range 235 to 280°C, irrespective of annealing temperature, grain size and fracture mode. Primary recrystallized specimens fractured mainly along the grain boundaries, but secondary recrystallized specimens fractured mainly by transgranular cleavage initiated from a grain-boundary source. These results are consistent with a picture of grain growth and embrittlement involving impurities segregated at the grain boundaries, the high DBTT in the recrystallized W being determined by the initiation of a brittle crack at a grain boundary. (auth)

45960 PHASE EQUILIBRIA IN THE THORIUM–THORIUM MONOPHOSPHIDE SYSTEM. Javorsky, C. A.; Benz, R. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. J. Nucl. Mater., 23: 192-8(1967). (LA-DC-8388).

The Th-ThP eutectic was observed at 1608 ± 20°C and at a P/Th ratio of 0.11 ± 0.02. The phase transition between saturated face-centered cubic and body-centered cubic Th occurs at 1360°C. The ThP phase is stable over a range of compositions with a minimum P/Th ratio of 0.98. The ThP phase melts congruently with the P/Th ratio of 0.99 ± 0.02 at 2990°C. (auth)

45961 THE OXIDATION MECHANISM OF PURE URANIUM IN CARBON MONOXIDE BETWEEN 700° AND 1000°C. Whittle, I.; Gerrish, M. E.; Stobbs, J. J.; Buddery, J. H. (Central Electricity Generating Board, Berkeley, Eng.). J. Less-Common Metals, 13: 200-12(Aug. 1967).

The oxidation kinetics of U in CO have been determined in the temperature range 700° to 1000°C and are more complex than in any other U oxidation system yet investigated at Berkeley Nuclear Laboratories. The rate of oxidation increases quite rapidly with temperature up to ~850°C and then decreases markedly with temperature. The kinetics have been qualitatively explained in terms of a UO_2-catalysed thermal decomposition of CO to CO_2 and carbon, the resulting CO_2 reacting with the U. The morphology of the reaction product (a layer of UO_2 covered by a thicker, duplex layer of UO_2 and UC_2) remains the same over the temperature range studied, but no convincing explanation of this order of layers can be put forward at this stage. (auth)

45962 EUROPIUM–LEAD SYSTEM. McMasters, O. D.; Gschneidner, K. A. Jr. (Ames Lab., Iowa). Contract W-7405-eng-42. J. Less-Common Metals, 13: 193-9(Aug. 1967). (IS-505).

The Eu–Pb phase diagram was established by differential thermal, metallographic and x-ray parametric methods. The terminal solid-solubilities in the system are less than 0.3 at. %. Eu additions raise the 327°C melting point of Pb to 328°C by a peritectic reaction. Three intermetallic compounds Eu_2Pb, EuPb and $EuPb_3$ melt congruently at 1250°, 1080° and 788°C, respectively. At 1145°C Eu_5Pb_3 forms by a peritectic reaction. Eu_2Pb crystallizes in the $PbCl_2$(C 23) type structure with orthorhombic lattice constants of a = 7.87, b = 5.40 and c = 10.03 Å. $EuPb_3$ crystallizes in the cubic $AuCu_3$($L1_2$) type structure with a_0 = 4.915 ± 0.001 Å. EuPb is dimorphic with the structure change occurring at 857°C upon heating for the Eu-rich side of the compound and 870°C upon heating for the Pb-rich side of the compound. The crystal structures of these two forms and that of Eu_5Pb_3 were not established. Eutectic reactions occur at 5.5 at. % Pb and 770°C, 44.5 at. % Pb and 1031°C and 63.5 at. % Pb and 717°C. (auth)

45963 STRAIN IN METAL CARBIDES. Gillies, D. C.; Lewis, D. (Univ. of Surrey, London). J. Less-Common Metals, 13: 179-85(Aug. 1967).

X-ray line broadening measurements have recently shown that ionic materials, such as alkali halides and metal oxides, may be heavily strained by ball-milling. This work has now been extended to some compounds containing atoms in interstitial sites. Those studied included some of the carbides of Ti, Zr, Ta, V, Nb, Mo and W. Ball-milling produced strain comparable to that observed after ball-milling the parent metal. In certain circumstances the strain can be removed by annealing. The induced strain has been compared with the free energy of formation as a parameter of bond strength. The presence of oxygen in the lattice causes some carbides to lose cubic symmetry and to deform more isotropically. Changes in lattice parameter were observed. (auth)

45964 STUDY OF THE PLASTIC CONSOLIDATION OF POLYCRYSTALLINE URANIUM DURING TENSILE TESTS CARRIED OUT IN α PHASE AT DIFFERENT RATES. Jean-Louis, F.; Daniel, J. S.; Lacombe, P. (Faculte des Sciences, Orsay, France). Mem. Sci. Rev. Met., 64: 593-603(June 1967). (In French).

Between 20 and 350°C the deformation occurs mainly in the grain interior, with superimposed twinning and slip mostly at the beginning of deformation. Between 350 and 500°C consolidation is less marked, and above 500°C the boundaries become mobile and a polygonal structure develops. (auth)

45965 STUDY OF THE CONTACT ZONE BETWEEN NUCLEAR FUEL AND CAN (URANIUM–ALUMINUM). Raviv, S.; Malkiely, S.; Gabriel, I. (Commission de l'Energie Atomique, Neguev, Israel). Mem. Sci. Rev. Met., 64: 537-45(June 1967). (In French).

The definition of the selective desorption conditions for the protective film on the fuel and its can is presented. The practical interest of the dissolution of the nuclear fuel at the fuel/can interface, and of the protection of the can is described. (auth)

45966 THE PREPARATION AND CRYSTAL STRUCTURE STUDIES OF SELECTED AB_2 RARE EARTH INTERMETALLIC COMPOUNDS WITH GROUP V AND VI ELEMENTS. Wang, Rong. Austin, Tex., Univ. of Texas, 1967. 138p.

Thesis.

A number of selected compounds of the rare earth elements, La, Ce, Ne, Sm, Gd, Dy, Ho, Er, and Yb in combination with the elements of chemical Groups V and VI, Sb, Se, and Te were prepared and their crystal structures studied. Data obtained from x-ray diffraction techniques indicated that these phases crystallized in four different crystal structures: Cu_2Sb, superstructures of Cu_2Sb, $LaSb_2$ and $ZrSi_2$. All $RETe_2$ compounds are isostructural with Cu_2Sb. It was proved that the Te atoms in the basal plane in some $RETe_2$ phases could be deficient and lead to a limited defect solid solution. The $RESe_2$ phases were grouped into two types of defect superstructures based on the $RETe_2$ fundamental structure. $YbSb_2$ was found as the first rare earth alloy isostructural with $ZrSi_2$. The $LaSb_2$, $CeSb_2$, $NdSb_2$, and $SmSb_2$ phases crystallize in the new $LaSb_2$ structure, which is closely related to the $RETe_2$ and $YbSb_2$ structures. The phases $YbSe_2$, $HoTe_2$, $ErTe_2$, $GdSb_2$, $DySb_2$, $HoSb_2$, and $ErSb_2$ could not be synthesized in this investigation. The absence of these phases was discussed based on their size factors. A number of ternary alloys

on the sections, $LaSb_2-LaTe_2$, "$LaSn_2$"$-LaSb_2$ and $LaSe_2-LaTe_2$ were prepared. A new orthorhombic structure which represents a distorted modification of the tetragonal Cu_2Sb structure was found when the Te atoms in $LaTe_2$ phases were substituted with Sb atoms. The derived Cu_2Sb orthorhombic form forms a continuous solid solution within the composition range $LaTe_2$ to $LaSb_{1.5}Te_{0.5}$. The formation and the relationship among these structures is discussed. The bond characters for these structures were quantitatively analysed. The type of bonding in each of these series of phases is not strictly limited, but allows for wide variations in relative proportions of metallic, covalent and ionic bonds. The $RESe_2$ and $RETe_2$ phases essentially have the bond character between metallic covalent and ionic while metallic bond character exists in the two $RESb_2$ structures. (Disser. Abst.)

45967 INTERMEDIATE PHASES IN THE MAGNESIUM–CERIUM SYSTEM BETWEEN MAGNESIUM AND Mg_3Ce. Crosby, R. L.; Holman, J. L. Rep Invest No. 6866. Washington, D. C., Bureau of Mines, 1966. 18p.

Microscopic and x-ray diffraction techniques were used to identify two intermediate phases in that part of the solid region of the Mg–Ce system between Mg and Mg_3Ce. Previous literature had reported only one intermediate phase for this region, but chemical analysis determined the approximate composition of the two intermediate phases was found to be limited to less than 0.3 at. % Ce. The study did not determine the crystal structure of $Mg_{17}Ce_2$, but that of $Mg_{23}Ce_2$ is tetragonal with a = 10.33 A. and c = 19.51 A. (Rev. Met. Lit.)

Radiation Effects

Refer also to abstracts 45303, 46025, 46870, 46963, 46964, and 46969.

45968 (AD–632539) ELECTRICAL PROPERTIES OF ELECTRON IRRADIATED GERMANIUM. Harmatz, Milton; Hollander, Peter (Army Electronics Command, Fort Monmouth, N. J. Inst. for Exploratory Research). Mar. 1966. 22p. (ECOM–2682). CFSTI.

Measurements of the electric properties of arsenic-doped germanium irradiated at 300°K with electrons and annealed at high temperatures are reported. Bombardments with 1.5-MeV electrons on 1.2 ohm-cm n-type material caused the conductivity to decrease initially to a minimum value after being irradiated with 7×10^{15} electrons/cm^2 and then to increase slowly with additional radiation. The negative Hall coefficient increased at first, and then exhibited a reduction when the fluence increased beyond 7×10^{15} electrons/cm^2. Hall effect measurements indicated that the material converted to p-type following a fluence of 1.1×10^{16} electrons/cm^2. Conversion was observed after the conductivity passed the minimum value. A small decrease of two per cent in the Hall mobility following a fluence of 7×10^{14} electrons/cm^2 was produced. The data indicated that the carrier removal rate was .6 carriers/electron cm. In irradiated 16 ohm-cm n-type material, which was converted to p-type, reversion occurred rather quickly at an annealing temperature of 312°K. The annealing rate was slower following the maximum resistivity and negative Hall coefficient values. The sample was not restored to its pre-irradiated condition following the highest annealing temperature conducted. (auth) (TAB)

45969 (EURAEC–1908) NEW METHODS FOR PHYSICAL INTERPRETATION OF TIME-TO-RUPTURE TESTS. Third Special Report. Siegfried, W. (Battelle Inst., Geneva (Switzerland)). Aug. 30, 1967. Contract 100-62-12-RDS. 165p. (EUR–3393). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

Values with a defined physical meaning, whose computation is possible on the basis of the physical elementary mechanisms taking place, have been calculated by means of time-to-rupture tests whose nominal stress and constriction of rupture as a function of time to rupture have been measured. These are the following: volume of activation as a function of stress; secondary creep rate as a function of stress; and number of fissure germs as a function of secondary creep rate. After discussion of simplifications based on investigations of an estimate of possible errors to be expected, and of determination of the field of validity, the mechanism of rupture formation during the time-to-rupture test is subdivided into the following classes of partial mechanisms: mechanisms of deformation characterized by the volume of activation and the part of volume participating in the deformation; germination and growth of fissures; and formation of a constriction. This subdivision permits the above-mentioned physical values to be determined without going into all details of the physical models. The following time-to-rupture tests are discussed in more detail: time-to-rupture tests on two Cr–Ni–Ti-alloys at different temperatures before and after neutron irradiation; in-pile time-to-rupture tests and corresponding off-reactor control tests on a 304-stainless steel at different temperatures; and time-to-rupture tests without neutron irradiation on a Cr–Mo–V cast steel with abnormal behavior. (auth)

45970 (EURAEC–1921) RESEARCH TO DETERMINE THE LONG-TERM MECHANICAL PROPERTIES OF METALS SUBJECTED TO MECHANICAL STRESS AT ELEVATED TEMPERATURES AND NEUTRON IRRADIATION. Final Report. Siegfried, W.; Zimering, S. (Battelle Inst., Geneva (Switzerland)). July 1967. Contracts 100-62-12RDS; 057-64-7TEES(RD). 61p. (EUR–3752). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

The relationships between the shape of time-to-rupture curves and certain kinematic values which can be calculated on the basis of the physical theories are presented for irradiated metals. A basis is obtained for developing new extrapolation methods by means of which the results of measurements of physical values can be introduced into the calculation quantitatively. It can be expected that a substantial reduction of cost and necessary test time can be achieved for determining the long-time mechanical properties at high temperature and under neutron irradiation. The results obtained also make it possible to evaluate summarily the available results of technological time-to-rupture tests which have been made at high temperatures and under neutron irradiation, and those of physical investigations as regards the influence of neutron irradiation on the mechanical properties. Considerable improvement of the situation towards determining the long-time mechanical properties and developing new materials can be expected from such an evaluation of investigations already available. (auth)

45971 GAMMA RADIATION EFFECTS ON THE ALUMINUM SURFACE PROPERTIES. Lepin, L. K.; Kadek, V. M.; Lusis, A. Kh.; Krast, Kh. B. (Inst. of Inorganic Chemistry, Riga). Zashch. Metal., 3: 613-15(Sept.-Oct. 1967). (In Russian).

Gamma radiation effects on metallic Al foils condensed in a vacuum and irradiated in a reactor in the air atmosphere (dry irradiation) with doses from 0.5×10^7 to 5.0×10^8 r and immersed in solution (wet irradiation) with 0 to 500 and up to 1000 r/sec at 20 to 30°C were investigated. The results obtained indicated reduced photoelectric responses and electric resistance (1.2 to 2.2 times) due to surface oxidation. Changes were also observed in the intensity and selectivity of light absorption by the 7×10^{-7} to 8×10^{-6} cm thick coatings blown on glass during evacuation from 5×10^{-5} to 2×10^{-4} mm Hg. The irradiated film became more transparent at the wave length of 300 to 600 mm and 1200 to 1300 mm and less transparent in the spectrum short-wave section. In the mean-wave section the maximum light absorption shifted after irradiation to the long-wave part from 530 (non-irradiated) to 700 nm (irradiated). Gamma irradiation enhanced primary phase oxidation in the film on the Al surface inducing degradation of the film. (R.V.J.)

45972 ON THE INFLUENCE OF THERMAL DEFECTS ON THE RADIATION STABILITY OF GERMANIUM. Mashovets, T. V.; Ryvkin, S. M.; Khansevarov, R. Yu. (Ioffe Inst. of Physics and Tech., Leningrad). Fiz. Tverd. Tela, 9: 535-8(Feb. 1967). (In Russian).

The influence of the extraction of residual Cu on the rate of formation of defects in Ge on γ-irradiation was studied. No effect on the rate was observed. The initial rate of defect formation decreased after heating Ge in Au and subsequent cooling, although this process introduced thermocenters with E_c levels at about 0.2 eV. These centers (possibly dislocations) are apparently points of "escape" of radiation defects. When Ge is treated thermally without Au, the acceptor levels are chiefly responsible for changes in the parameters of the material. These acceptor levels are located below the level for atomic Cu at $E_v = 0.04$ eV. (BBB)

45973 LOW TEMPERATURE INTERNAL FRICTION IN NEUTRON IRRADIATED NIOBIUM. Stanley, M. W.; Szkopiak, Z. C. (Univ. of Surrey, London). J. Nucl. Mater., 23: 163-72(1967).

Low frequency internal friction measurements, at 100 to 290°K, have been carried out on neutron-irradiated Nb. Two relaxation peaks, or groups of peaks, have been observed, one at about 110°K, and the other at about 210°K. These peaks have, respectively, been identified as α and β peaks observed in cold-worked bcc metals. The height of the α peak decreases and that of the β peak increases with increasing dose of irradiation within the order of magnitude of 10^{18} nvt. On isochronal annealing (2 h pulses) the heights of the peaks have been found to increase at 65 to 200°C, the increase in

the height of the β peak being much more pronounced. This temperature range fits into the so-called Stage III annealing in bcc transition metals. On annealing at higher temperatures the heights of the peaks decrease to negligible values at about 380°C. The relaxation mechanisms causing the peaks have been discussed in terms of a dislocation (Bordoni type) process, a dislocation-point defect (Hasiguti type) process and point defect complexes. The general conclusion is that the α peak is caused by the processes involving dislocations and the β peaks are caused by processes involving point defects created by irradiation and interstitial impurities. (auth)

45974 GROWTH OF GAS BUBBLES IN A STRESSED MEDIUM AND THE APPLICATION TO STRESS ENHANCED SWELLING IN ALPHA URANIUM. **Harrison, J. W. (United Kingdom Atomic Energy Authority, Harwell, Eng.). J. Nucl. Mater., 23: 139-53 (1967).**

The growth of gas bubbles in a solid under the influence of internal stress gradients is discussed, and the theory is applied to the swelling of α U under irradiation. In assessing the growth rates of bubbles in α U it is shown that it is the irradiation processes themselves which produce the internal stresses necessary for bubble growth, and the process is shown to be both temperature and rating dependent. Because of the existence of a critical radius for bubble growth it is shown that there is an incubation period beyond which bubble growth can quite rapidly lead to a breakaway swelling. A maximum in the stress enhanced swelling is predicted in the temperature range 400°C to 500°C and is shown to be due to the temperature dependence of the internal stresses. Quantitative agreement is found between theory and experiment over a range of temperature and burn-up rates. (auth)

45975 RADIATION EFFECTS ON CREEP RUPTURE AND FATIGUE STRENGTH OF PURE ALUMINUM. **Zamrik, S. Y.; Hu, L. W. (Pennsylvania State Univ., University Park). Exp. Mech., 7: 193-201(May 1967).**

Effects of nuclear-reactor radiation on the creep rupture and fatigue strength of pure Al for the ratios of alternating stress σ_a to mean stress σ_m ranging from zero to infinity was studied. An analytical model was developed to correlate creep rupture and fatigue strength for various ratios of σ_a/σ_m including the radiation effect. After exposure to an integrated fast-neutron flux of 1×10^{18} nvt in a swimming-pool-type reactor, irradiated specimens were removed from the reactor core and visually examined. They were discolored and coated with a film of light gray color; however, no other visible changes such as cracks, distortion, or corrosive scale could be detected. X-ray diffraction patterns identified the light gray film as Bayerite or β-$Al(OH)_3$. The yield stress of the annealed specimens increased from 2000 to 6380 psi after irradiation (an increase of 219%), whereas the ultimate strength and ductility were essentially not affected. The yield stress, ultimate strength, and ductility of the pure Al in as-received condition were not significantly affected by neutron radiation. However, it did produce a discontinuous yield point in the pure Al in as-received condition. For a short life (no. of stresses, $N = 10^4$), a linear relation was found to exist between the alternating stress and the mean stress, resulting in a straight line up to a ratio of stresses about 1.3. Above this stress ratio, the stress curve deviated from a straight line and became slightly curved. The deviation became more noticeable as the failure-life increased from 10^4 to 10^7 cycles and the ratio of stresses decreased. For example, the stress curve for a ratio of stresses greater than 0.17 at a life 10^7 cycles became an almost horizontal line parallel to the σ_m axis. (BBB)

45976 DEISTVIE IONIZIRUYUSHCHIKH IZLUCHENII NA METALLY I SPLAVY. (Effects of Ionizing Radiation on Metals and Alloys). **Shalaev, A. M. Moscow, Atomizdat, 1967. 116p.**

The effects of ionzing radiation (electron beams, γ radiation, and x rays) on metals and alloys were examined. The interactions of electrons and γ radiation with matter is discussed. The changes in the physical properties of metals and alloys under the effects of ionizing radiation (electroconductivity, Young's modulus, mechanical characteristics, phase composition of metallic systems, and magnetic properties) were examined. The effects of radiation on diffusion and ordering processes in metals and alloys were also considered. 177 references. (J.S.R.)

Ceramics and Cermets

45977 (WCAP-3791-8) URANIUM PLUTONIUM CARBIDE DEVELOPMENT QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING JUNE 30, 1967. **Ray, William E. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). July 1967. Contract AT(30-1)-3791. 70p. Dep. CFSTI.**

A basic fuel element design suitable for application in a commercial, liquid metal-cooled, fast breeder reactor (LMFBR) is described. Vented and sealed element designs are presented. The fuel used in both types of elements is a stabilized (U,Pu)C solid solution. For heat transfer reasons, the (U,Pu)C is Na-bonded to the fuel element claddings. (auth)

Corrosion and Erosion

45978 HIGH-TEMPERATURE OXIDATION OF WC–TaC–Co ALLOYS. **Meerson, G. A.; Funke, V. F.; Panov, V. S. (Moscow Inst. of Steel and Alloys). Izv. Akad. Nauk SSSR, Neorg. Mater., 3: 887-90(May 1967). (In Russian).**

The oxidation kinetics of WC–TaC–Co were investigated at different ratios of the carbide components WC : TaC and constant concentration of Co at 25 wt % in the temperature interval from 500 to 800°C. The results showed that the introduction of TaC into the alloy WC–Co increases its stability against oxidation in air. (J.S.R.)

45979 ANISOTROPY OF GRAPHITE REACTIVITY. **Volkov, G. M.; Kalugin, V. I. Dokl. Akad. Nauk SSSR, 174: 121-3 (May 1, 1967). (In Russian).**

The oxidation rate of pyrographite specimens in air was investigated. The density of tested pyrographite was 2.15 g/cm^3 and the content of impurity atoms was less than 1×10^{-4}. Graphite specimens with a density of 2.15 g/cm^3 have a crystal orientation parallel and perpendicular to the oxidation surface, which made it possible to determine the values of R_a and R_c separately. The dependence of graphite reactivity on temperature is shown. It was determined that $R_a = 1.1 \cdot 10^3 e^{-29500/RT}$ $g/cm^2 \cdot min$ and $R_c = 7.0 \cdot 10^2 e^{-29500/RT}$ $g/cm^2 \cdot min$ and the ratio $R_a/R_c = 1.5$ to 2.0. In the case of graphite with an irregular orientation of crystalline grains, $R = 9.1 \cdot 10^2 e^{-29500/RT}$ $g/cm^2 \cdot min$. (ATD)

Preparation and Fabrication

Refer also to abstracts 45068, 45869, 46843, 46916, 46992, and 46993.

45980 (JUL-472-RW) UNTERSUCHUNGEN AN URANNITRIDEN UND -CARBONITRIDEN. (Investigations on Uranium Nitrides and Carbonitrides). **Naoumidis, A. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe). Mar. 1967. 111p. (In German). Dep.**

Investigations were carried out on the U–N system, on mixed-crystal formation of UN with UC, and on the hypothetical UO system. The following systems were studied: the single phase region U_2N_2–UN_2, the formation of the β phase of U_2N_3, and the UN–UC–UO system. The various phases were prepared and investigated by x rays and metallographically. N equilibrium pressures of these phases were measured as a function of temperature and composition. From these measurements the thermodynamic magnitudes ΔG, ΔH, and ΔS of the formation of the various phases were calculated. The composition of the compounds prepared was determined by a modified N_2 analysis. (tr-auth)

45981 (ORNL-4145, pp 180-207) SOL-GEL PROCESSES FOR THE URANIUM FUEL CYCLE. (Oak Ridge National Lab., Tenn.).

Efforts in the application of sol-gel techniques to the uranium cycle are described. A flowsheet for the engineering-scale preparation of urania sol was developed. The preparation of urania sol by solvent extraction is described. Laboratory studies and engineering scaleup of the plutonia sol-gel process were continued. Methods of producing sol-gel oxide (ThO_2 and UO_2) microspheres having controlled porosity were investigated. (M.C.G.)

45982 OBTAINING THIN FILMS OF MOLYBDENUM CARBIDE FROM MOLYBDENUM HEXACARBONYL UNDER THE ACTION OF AN ELECTRON BEAM. **Vishnyakov, B. A.; Osipov, K. A. (Inst. of Metallurgy, Moscow). Sov. Phys.-Solid State (Engl. Transl.), 9: 1216-17(Nov. 1967).**

Translated from Fiz. Tverd. Tela, 9: 1545-7(May 1967).

The effects of substrate temperatures ranging from –25 to +300°C on the growth rate and electric properties of thin molybdenum carbide films formed by electron irradiation of molybdenum hexacarbonyl molecules adsorbed on the substrate were studied. At temperatures from –25 to +30°C, the growth rate of the film dropped exponentially with increasing temperature. At 30 to 100°C, the growth rate remained almost unchanged with increasing temperature. At substrate temperatures greater than 100°C, the growth rate increased with

increasing temperature. Electrical resistivity data on the molybdenum carbide films obtained are tabulated. (A.G.W.)

45983 INVESTIGATIONS OF THE CONDITIONS FOR THE PRODUCTION OF HEXABORIDES OF THE RARE EARTHS AND ALKALI EARTH METALS OF HIGH PURITY. Meerson, G. A.; Mamedov, F. G. (Moscow Inst. of Steel and Alloys). Izv. Akad. Nauk SSSR, Neorg. Mater., 3: 802-7(May 1967). (In Russian).

Methods for production of hexaborides of rare earth metals and alkali earth metals of stoichiometric composition and high purity were developed. The optimum regime for production of the hexaborides of stoichiometric composition was established by the vacuum borothermal method at 1,800°C with 5% excess of B over the calculated value. Complex binary borides of Ba and Sr and ternary borides of Ba, Sr, and Ca were synthesized. (tr-auth)

45984 KINETICS OF WSi_2 GROWTH ON SILICON. Hashimoto, Norikazu (Hitachi Ltd., Tokyo). Trans. Met. Soc. AIME, 239: 1109-11(July 1967).

The analysis of growth kinetics of WSi_2 on silicon substrate is presented. The reflection electron diffraction data for the grown coating at 1150°C are listed. (D.C.C.)

45985 ON THE PREPARATION OF SOME CHROMIUM, MOLYBDENUM, AND TUNGSTEN BORIDES. Peshev, P.; Bliznakov, G.; Leyarovska, L. (Inst. of General and Inorganic Chemistry, Sofia). J. Less-Common Metals, 13: 241-7(Aug. 1967).

The formation of CrB_2, Mo_2B_5, and W_2B_5 by reactions of Cr_2O_3, MoO_2, and WO_2 with elemental B in vacuum was investigated. It was established that the borothermic reduction of Cr_2O_3 is complete at temperatures above 1600°C, CrB_2 containing CrB being obtained; the amount of CrB increased with increasing temperature. The reaction between MoO_2 and B at low temperatures led to a partial reduction of the dioxide to Mo_2O_3. Formation of Mo_2B_5 began above 1200°C and at 1600°C the only pure compound was obtained. Mo_2B_5 has a defect structure. The optimum temperature for borothermic preparation of W_2B_5 was also 1600°C. The product obtained displayed a certain deficiency of B. At low temperatures W_2B-phase was obtained, while above 1600°C, monoboride, WB, was formed simultaneously with W_2B_5. (auth)

45986 THE MIXED CRYSTAL EuO–SrO AND THE NEW PROCESS FOR THE PREPARATION OF EuO. Brauer, G.; Schultz, N. (Univ., Freiburg i. B.). J. Less-Common Metals, 13: 213-18(Aug. 1967). (In German).

Homogeneous phases of the mixed oxides EuO and SrO have been prepared by the reaction of appropriate mixtures of the oxides Eu_2O_3 and SrO with the hydrides SrH_2 and EuH_2 at about 800°C. The mixed crystal phases exhibit like the pure oxides, the crystal structure of the NaCl-type. The lattice constants follow Vegard's law. Pure monoxide EuO can be prepared by the same reaction starting with Eu_2O_3 and EuH_2. (auth)

45987 IMPROVEMENTS IN OR RELATING TO GRAPHITE. Longstaff, Brian (to United Kingdom Atomic Energy Authority). British Patent 1,087,046. Oct. 11, 1967. Filed June 9, 1965.

A method for the production of a graphite is described for a high temperature gas-cooled reactor. The graphite fuel tube is fabricated with 50% of the open porosity pores of size 5 to 10 microns, and the remainder being under 0.1 microns. The viscous permeability constant is below 3×10^{-11} cm^2 and the fission gas transmission coefficient is below 10^{-6} cm^2/sec. (J.C.W.)

45988 URANIUM MONONITRIDE: SODIUM PASTE NUCLEAR FUEL. Nelson, Paul A.; Chasanov, Martin G. (to U. S. Atomic Energy Commission). U. S. Patent 3,338,840. Aug. 29, 1967.

A blanket fuel was developed for a fast breeder reactor consisting of a paste of UN particles having a median size no greater than 100 microns and a density of at least 8.0 g/cc dispersed in Na. (AEC)

45989 IMPROVEMENTS IN OR RELATING TO NUCLEAR FUEL MATERIAL. Hüddle, Roy Alfred Ulfketel; Beutler, Hans (to United Kingdom Atomic Energy Authority). British Patent 1,077,667. Aug. 2, 1967. Filed Oct. 8, 1963.

Reactor fuel pellets, of spherical shape, are formed by powder metallurgy techniques from a mixture of ZrC and UC, sintered, and coated in a fluidized bed type of furnace at 1600°C in two stages with pyrolytic C derived from a hydrocarbon gas. The two stage coating may consist of laminar or columnar pyrolytic C, or a mixture of the two, or the second layer may be of SiC derived from methyltrichlorosilane. It is postulated that the duplex coating process increases fission product retention. (P.G.C.)

45990 PROCESS FOR THE PREPARATION OF THORIUM DIOXIDE–URANIUM OXIDE SOLS. Fitch, Frederick Troop; Smith, Jean Gillen (to W. R. Grace and Co.). British Patent 1,079,576. Aug. 16, 1967. Priority date Nov. 2, 1964, United States.

A ThO_2–UO_2 aquasol, for use in nuclear fuels, is prepared by removal of chloride ions from a $ThCl_4$–UCl_4 solution with an anion exchange resin, filtering, and autoclaving the deionized filtrate. An alternate method specifies mixing the sols of ThO_2 and UO_2 prepared separately by the same de-ionization process. Analysis by x-ray diffraction indicates that part of both components enter into solid solution. The colloidal particles may be dehydrated by centrifuging, vacuum distillation, or extraction and used as ceramic powders. (P.G.C.)

45991 METHOD OF PRODUCTION OF ACTIVE BERYLLIUM OXIDE. (to Nippon Gaishi Kabushiki Kaisha). British Patent 1,080,253. Aug. 23, 1967. Priority date Dec. 26, 1963, Japan.

Finely divided BeO powder, having a high specific surface area, i.e., 6.3 to 7.5×10 m^2/g as compared with ordinary BeO which has a surface area of 1.5 to 1.7×10 m^2/g, is prepared by dissolving a Be salt in an aqueous solution containing H_2SO_4, HNO_3, HCl, or NH_4OH, adjusting the pH to between 1.5 and 5.0, evaporating the solution, and thermally decomposing the complex at 300 to 1200°C. Addition agents as $(NH_4)_2SO_4$, $(NH_4)_2CO_3$, $H_2C_2O_4 \cdot 2H_2O$, and others assist in producing a finely divided powder. The product sinters more readily than those currently on the market and is suitable for use as a refractory or as a catalyst. (P.G.C.)

45992 IMPROVEMENTS IN OR RELATING TO METHODS OF FORMING NUCLEAR FUEL BODIES. Redding, Geoffrey Brian; Lamb, David Norman (to United Kingdom Atomic Energy Authority). British Patent 1,081,447. Aug. 31, 1967. Filed Oct. 30, 1964.

Nuclear fuel particles, pre-coated with pyrolytic carbon as a fission product retaining layer, are rolled in a drum with binder-treated grains of a matrix forming material, such as graphite, which are sprayed with a binder solvent mist during the rolling. The spherical particles so produced, consisting of fuel material and matrix coating, are heated in vacuum to 50°C to remove excess solvent and hot pressed in dies at 800°C and 1000 psi to set the binder. (P.G.C.)

45993 IMPROVEMENTS IN OR RELATING TO THE MANUFACTURE OF REFRACTORY COMPOUNDS. Fletcher, John Molyneux; Hyde, Kenneth Robert; Roberts, Fred (to United Kingdom Atomic Energy Authority). British Patent 1,084,338. Sept. 20, 1967. Filed Aug. 7, 1963.

A process is described for the production of refractory compounds consisting of a metallic portion and a nonmetallic portion in which the metallic portion is V, Ti, Th, Nb, Zr, Hf, W, Mo, Ta, U, Pu, or Si and the nonmetallic portion is nitride, boride, phosphide, silicide, or sulfide. Oxide particles of the metallic portion of the compound are reacted with C or with a C-containing material in a fluidized bed reactor to form the carbide, which is then reacted in a fluidized-bed reactor with a substance consisting of or containing the nonmetallic portion of the refractory compound. (B.L.M.)

Properties Evaluations

Refer also to abstracts 45023, 45899, 45980, 46963, and 46964.

45994 (CEA-Bib-86) COMPORTEMENT DES COMBUSTIBLES DISPERSES DE HAUTE TEMPERATURE VIS-A-VIS DES PRODUITS DE FISSION. (Behavior of Dispersed Nuclear Fuels at High Temperature with Regard to the Fission Products). Ortega, Miguel (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). July 1967. 24p. (In French). Dep.

Thesis.

In the first part, the main properties and processes for the fabrication of dispersed fuels formed by coated fuel particles contained in a moderating matrix are summarized. This new type of nuclear fuel being intended to work at very high temperatures, the problem of retention of fission products presents a fundamental interest. In the second part, the knowledge gained in this field during the last few years and the solutions proposed for resolving this complicated problem are reviewed. (auth)

45995 (DP-1116) HIGH-TEMPERATURE STABILITY OF THULIUM OXIDE. Smith, P. Kent (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Sept. 1967. Contract AT(07-2)-1. 17p. Dep. CFSTI.

The material properties of Tm_2O_3 make ^{170}Tm attractive for use in high-temperature isotopic power sources. To establish specifications for reactor target materials suitable for irradiation in forms that might be considered for direct use in isotopic power

sources, the high-temperature stability of Tm_2O_3 was calculated from thermodynamic data; the temperature dependence of vapor pressure, the boiling point, and the heat of vaporization were derived. Data indicate that the oxide is exceptionally refractory. (auth)

45996 (GEMP-545) FABRICATION AND MEASUREMENT OF PROPERTIES OF Mo-UO_2 CERMETS. Collins, J. F.; Flagella, P. N. (General Electric Co., Cincinnati, Ohio, Nuclear Materials and Propulsion Operation). July 7, 1967. Contract AT(40-1)-2847. 24p. Dep. CFSTI.

The fabrication of 90 specimens of various Mo-UO_2 fuel types and the measurement of tensile strength, thermal expansion, thermal conductivity, and sonic velocity is presented. Variables such as fuel particle size, fuel loading, and the effect of cladding or coatings of Mo over the Mo-UO_2 cermet were investigated. (auth)

45997 (IN-1093) ZIRCALOY-4, URANIUM DIOXIDE, AND MATERIALS FORMED BY THEIR INTERACTION. A LITERATURE REVIEW WITH EXTRAPOLATION OF PHYSICAL PROPERTIES TO HIGH TEMPERATURES. Hammer, R. R. (Idaho Nuclear Corp., Idaho Falls). Sept. 1967. Contract AT(10-1)-1230. 38p. Dep. CFSTI.

The physical properties of UO_2, ZrO_2, UO_2-ZrO_2 solid solutions, ZrO_{2-x}, and Zircaloy-4 have been reviewed. Recommended and extrapolated values of these physical properties are given. The properties covered are: transition temperatures, heat capacities, heat contents, vapor pressures, thermal conductivities and thermal expansion. The temperature ranges and materials covered were geared for use in the analysis of a loss-of-coolant reactor accident. (auth)

45998 (UCRL-70580) DETERMINATION OF OXYGEN DIFFUSION IN CERAMICS BY MEANS OF NUCLEAR ACTIVATION. Condit, Ralph H.; Holt, J. Birch (California Univ., Livermore. Lawrence Radiation Lab.). Oct. 2, 1967. Contract W-7405-eng-48. 12p. (CONF-671016-1). Dep. CFSTI.

From Joint Meeting of the German Physical, Glass Industry, and Ceramic Societies, Erlangen, Germany.

A technique which makes it possible to use the rare isotopes of oxygen, ^{17}O and ^{18}O, as if they were radioactive tracers was developed for studying oxygen transport. For this purpose, a little of the concentrated isotope is incorporated at selected points within a ceramic specimen, the sintering or reaction experiment is carried out, and the isotope is then converted to the radioactive species ^{18}F by nuclear activation bombardment with 1-MeV deuterons or 2.8-MeV protons. The consequence of this is that ^{17}O or ^{18}O may be used as if they were radioactive tracers, the important difference being that they remain non-active until after an experiment and only then are they converted to a radioactive form. The principal purpose for using this approach is to make possible the use of autoradiographic film techniques which can serve to precisely locate the oxygen tracer and measure its concentration. The application of this technique to several studies in ceramics is discussed. (P.C.H.)

45999 (BNWL-tr-23) STUDY OF THE CATALYTIC COMBUSTION OF GRAPHITE. Amariglio, H.; Duval, X. Translated by Jane Heineman (Battelle Memorial Inst., Richland, Wash.), from Carbon, 4: 323-32(1966). 24p. Dep. CFSTI. JCL $2.60 fs, $0.92 mf.

Studies were made on the catalytic combustion of graphite by various metals. The combustions were carried out in such a way as to isolate the traits belonging to the catalyst, both by separating the non-catalyzed reaction, and by using a combustive air carefully purified of all trace of water vapor, whose promoting action is considerable and quite universal. Lead showed the strongest activity among those used. The production of CO and CO_2 was measured when possible. It was concluded that the catalysis of the oxidation of carbon consists essentially in a succession of alternate oxidations and reductions of the active agent. (P.C.H.)

46000 DEPENDENCE OF THERMOELECTROMOTIVE FORCES OF Nb AND Hf MONOCARBIDES ON THE C CONTENT IN THEIR HOMOGENEOUS REGIONS. Kuchma, A. Ya. (Inst. of Problems on Depleted Materials, Moscow). Izv. Akad. Nauk SSSR, Neorg. Mater., 3: 884-6(May 1967). (In Russian).

Thermal emfs of Nb and Hf monocarbides were measured as a function of the C content in their homogeneous regions. The emf of Nb carbide showed a maximum at 45 to 48 at. % C. The emf of Hf carbide had a maximum at 43 to 45 at. % C. (J.S.R.)

46001 MEASUREMENT OF THE THERMAL CONDUCTIVITY AND ELECTRICAL CONDUCTIVITY OF ZrC, HfC, NbC AND TaC AT HIGH TEMPERATURES. Paderno, Yu. B.; Barantseva, I. G.; Yupko, V. L. pp 199-204 of Vysokotemperaturn Neorgan Soedineniya. Kiev, Nauk Dumka, 1965. (In Russian).

The thermal conductivity and electric resistivity of ZrC, HfC, NbC, and TaC at 1370 to 3270°K were measured in an atmosphere of Ar for specimens prepared by hot pressing. In all studied carbides apart from NbC, the increase in thermal conductivity with temperature was linear. Such an increase was not due to heat transfer by radiation in the pores of the specimens or by the thermal conductivity of Ar. The electric resistivity also increased with temperature, but values of the electrical resistivity are somewhat higher than published data. This apparently can be explained by the deviation from stoichiometric composition. (Rev. Met. Lit.)

46002 VAPORIZATION OF ALKALINE-EARTH AND RARE-EARTH METAL DICARBIDES. Cuthbert, J.; Faircloth, R. L.; Flowers, R. H.; Pummery, F. C. W. (Atomic Energy Research Establishment, Harwell, Eng.). Proc. Brit. Ceramic Soc., No. 8, 155-73(June 1967).

Pure samples of CaC_2, SrC_2, BaC_2, SmC_2, and EuC_2 were prepared by direct combination of the elements in sealed molybdenum bombs at ca 2000°C. The pressures of the respective metal vapors in equilibrium with the dicarbides at 1000 to 1600°C were measured by means of a Knudsen effusion apparatus. Observation of the variation of vapor pressure with solid phase composition showed that addition of excess C does not affect the dicarbide phases significantly. Mass-spectrometer measurements confirmed the enthalpies of vaporization and showed that the monatomic metal is the only significant vapor species. Enthalpies of formation of the dicarbides are reported. (auth) (UK)

46003 LOW TEMPERATURE MAGNETIC TRANSITION IN PLUTONIUM MONOCARBIDE. Green, J. L.; Arnold, G. P.; Leary, J. A.; Nereson, N. G. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. J. Nucl. Mater., 23: 231-2 (1967). (LA-DC-8532).

Neutron diffraction patterns taken for a PuC target fabricated by arc melting ^{240}Pu metal and spectroscopic grade graphite indicated an antiferromagnetic transition at approximately 100°K. (H.D.R.)

46004 ADSORPTION OF OXYGEN ON SINTERED PLUTONIUM DIOXIDE. Stakebake, J. L.; Dringman, M. R. (Dow Chemical Co., Golden, Colo.). Contract AT(29-1)-1106. J. Nucl. Mater., 23: 349-51(1967).

The adsorption of O_2 on PuO_2 prepared by igniting a substoichiometric oxide in an O_2 atmosphere at 800°C was investigated. This sintering process practically eliminates the possibility of further metal oxidation or interstitial absorption of O_2 and permits the effects of sintering on the oxide surface and subsequent O_2 adsorption to be evaluated. (H.D.R.)

46005 VARIATIONS IN SOME PROPERTIES OF SINTERED TUNGSTEN CARBIDE-COBALT ALLOYS WITH PARTICLE SIZE AND BINDER COMPOSITION. Suzuki, Hisashi. Trans. Jap. Inst. Metals, 7: 112-17(Apr. 1966).

Properties of two-phase cemented carbides are decisively affected by the W content in the binder phase, (the carbon content of alloys) and are influenced by the particle size of carbide. Properties of WC-10% Co alloys were examined. Determination of the mean particle size by the coercive-force method appeared to be erroneous. Both hardness and electric resistivity of the alloys decreased with increasing carbon content and grain size. The strength of the alloys reached a maximum value at a definite point of the two-phase region depending on the binder composition and grain size. The lattice parameter of the binder phase and the magnetic saturation of the alloys were independent of grain size. The stability of the low-C alloys at high temperatures was strongly affected by grain size. (Rev. Met. Lit.)

46006 THERMAL SIMULATION OF IN-REACTOR MICROSTRUCTURES IN ThO_2-UO_2. Kerr, John M. (Babcock and Wilcox Co., Lynchburg, Va.). J. Amer. Ceram. Soc., 50: 449-53 (Sept. 21, 1967).

A device was built to provide the capability for out-reactor simulation of the microstructures seen in irradiated fuel. Out-reactor simulation of nuclear heating makes possible the precise measurement of temperature gradients in the fuel and provides data for correlating microstructural alterations with temperature. The simulation apparatus was designed to produce controlled thermal gradients sufficient to produce both equiaxed and columnar grain growth in the specimens. Provision was made for calorimetric measurements from which thermal conductance could be determined. Microstructural alterations in UO_2 and ThO_2-UO_2 materials were achieved, and thermal conductivity data were recorded. Microstructural alterations in the ThO_2-10 wt % UO_2 specimens were similar to those that other investigators have observed in UO_2 at lower temperatures. (auth)

46007 VAPOR PRESSURE, ENTHALPY, EVAPORATION COEFFICIENT, AND ENTHALPY OF ACTIVATION OF THE

BERYLLIUM NITRIDE (Be_3N_2) DECOMPOSITION REACTION. Hoenig, Clarence L.; Searcy, Alan W. (Univ. of California, Livermore). J. Amer. Ceram. Soc., 50: 460-6(Sept. 21, 1967).

Beryllium nitride (Be_3N_2) vaporizes congruently in the range 1640 to 1960°K by the reaction $Be_3N_2(c) = 3Be(g) + N_2(g)$. The equilibrium nitrogen partial pressure, in atmospheres, at the composition for congruent sublimation is given by the expression $\log P_{N_2} = [(-1.952 \pm 0.038) \times 10^4]T^{-1} + (6.509 \pm 0.207)$. The measured enthalpy of decomposition (370 ± 5 kcal at 298°K) yields an enthalpy of formation for $Be_3N_2(c)$ of −136 ± 6 kcal/mole. The upper limit to the evaporation coefficient at 1600 to 2000°K can be set as 10^{-4} by comparison of equilibrium data to Langmuir data obtained with a sample of 18% porosity. The apparent enthalpy of activation for the reaction is 409 ± 7 kcal/mole at 1800°K for the porous Langmuir specimen. An expression is developed to predict the temperature dependence of the reduced apparent pressures in Knudsen studies of substances with low evaporation coefficients in terms of the enthalpy of activation. The variation in temperature dependence of the Langmuir measurements and Knudsen measurements with three different-sized orifices is consistent with predictions from this expression. (auth)

46008 EFFECT OF STOICHIOMETRY ON THE THERMAL EXPANSION OF TaC_x. Fries, R. J.; Wahman, L. A. (Los Alamos Scientific Lab., N. Mex.). J. Amer. Ceram. Soc., 50: 475-7(Sept. 21, 1967).

The X-ray thermal expansion of TaC_x was measured over the composition range from $TaC_{0.789}$ to $TaC_{0.997}$ at temperatures to 1000°C. The average thermal expansion coefficient, $\bar{\alpha}$, increased with increasing formula weight; $\bar{\alpha}$ from 25 to 1000°C is 6.04, 6.37, and 6.96×10^{-6}/°C for $TaC_{0.789}$, $TaC_{0.912}$, and $TaC_{0.997}$, respectively. (auth)

46009 MAGNETIC PROPERTIES OF NEW OXIDES OF DIVALENT EUROPIUM CONTAINING TRIVALENT IONS OF 3d AND 4f TRANSITION METALS. Samokhvalov, A. A.; Bamburov, V. G.; Volkenshtein, N. V.; Zotov, T. D.; Morozov, Yu. N.; Simonova, M. I. (Institut Fiziki Metallov, Sverdlovsk, USSR). Fiz. Tverd. Tela, 9: 559-63(Feb. 1967). (In Russian).

The new compounds $Eu_3Al_2O_6$, $Eu_3Cr_2O_6$ (both cubic), $EuSc_2O_4$ (not determined), Eu_3O_4, $EuGd_2O_4$, and $EuDy_2O_4$ (rhombic) were obtained and their magnetic properties determined. These properties depend on the magnitude of the spin magnetic moment introduced by the 3d or 4f transition metal; in most cases an increase in the exchange interaction energy occurs with an increase in the Curie temperature. Data for the temperature dependence of magnetizability of the Al, Cr, and Gd compounds are given, and magnetization curves at 4.2°K for the Al, Cr, Gd, and Dy compounds are presented. A graph illustrates the dependence of magnetizability of the Al and Cr compounds on T^2 and $T^{\frac{1}{2}}$ at low temperatures. The lack of correlation between observed and calculated molecular magnetic moment may be related to a non-collinear ordering of ionic magnetic moments. (BBB).

46010 LOW TEMPERATURE ADSORPTION OF OXYGEN ON PLUTONIUM DIOXIDE. Stakebake, J. L. (Dow Chemical Co., Golden, Colo.). Contract AT(29-1)-1106. J. Nucl. Mater., 23: 154-62(1967).

The adsorption of oxygen on substoichiometric PuO_2 has been investigated between 76°K and 193°K. The process appears to follow a physical type of adsorption expressed as: Oxygen (adsorbed) $\underset{K_P}{\rightleftharpoons}$ Oxygen (gas). The free energy change and differential heat of adsorption of oxygen at a monolayer coverage and T = 85°K were 0.595 and 0.675 kcal/mole respectively. Both the free energy and heat of adsorption were found to decrease with increasing surface coverage. The differential entropy was negative up to a relative coverage of $\theta = 1.90$ with a minimum of −1.16 cal/mole·deg at $\theta = 1.02$. Results imply that the oxygen molecules are initially adsorbed by the interaction of an oxygen molecule with a (100) face of a single PuO_2 unit cell. Additional adsorption up to monolayer coverage takes place in a less specific manner. The adsorption was investigated using a volumetric apparatus. The surface area was determined by nitrogen adsorption and application of the BET theory. The calculated surface area of the oxide used throughout the experiment was 16.9 m^2/g. (auth)

46011 THERMOCHEMICAL, COMPATIBILITY, AND WETTABILITY STUDIES OF HIGH-TEMPERATURE MOLYBDENUM-RHENIUM BASE CERMETS. Manning, Charles Richard Jr. Raleigh, N. C., North Carolina State Univ., 1967. 146p.

Thesis.

An investigation was undertaken to determine the stability, compatibility, and adhesion of various high melting oxides, borides, nitrides, and carbides in combination with Groups VIB and VIIB refractory metals. Thermochemical studies were made to predict the degree of stability between ceramics and high melting metals at 1730°C and 2230°C. Compatibility studies were carried out in vacuum and He to 2500°C to confirm the predictions. Wettability studies were made in vacuum and helium at temperatures as high as 2730°C on refractory oxides, carbides, and nitrides utilizing liquid Cr, Armco Fe, Mo, and Mo-40 weight percent Re, Pt, Rn, and V. Liquid vapor interfacial energies σ_{LV} were determined from the liquid drop shape, and utilizing solid-vapor interfacial energies σ_{SV} available, the solid-liquid interfacial energies σ_{SL} as well as the work of adhesion W_a was calculated for the various metal-ceramic combinations. The results of these studies were analyzed to allow prediction of suitable metal-ceramic system for high temperature cermets. The thermochemical studies predicted excellent stability between the oxides, carbides, and nitrides in contact with Mo, Re, and W below 2230°C and instability between the borides and C. Further, thermodynamic data were lacking for prediction of results between borides and refractory metals. Compatibility experiments showed that the three refractory metals were stable in contact with carbides, oxides, and nitrides to 2450°C with two exceptions. These occurred when Ce_2O_3 in contact with W reacted at 1700°C to form $Ce_2(WO_3)$, and the Mo-Re alloy in contact with tungsten carbide above 2000°C scavanged the C from the W to form Mo−Re_2C. During exposure at 2200°C to 2300°C, the borides reacted with both Mo−Re and elemental Re to form the probable compounds $ReTaB_2$ and $ReNbB_2$. Further, the NbB_2 in contact with C was found to be reduced at temperatures above 2000°C. Sessile drop tests indicated little wetting occurred between refractory metals and oxides although the wetting could be improved by raising the test temperature. The most promising metal-oxide system was V on ZrO_2. In this system, a contact angle of 46° was noted at 1700°C indicating partial wettability. Much better wetting was found for the refractory metals on the carbides where the contact angles ran from 25° to 0°. An x-ray diffraction analysis made in conjunction with these studies showed limited solubility of the Mo−Re alloy in ZrC and HfC, whereas complete solubility of the binder (up to the 25 vol % of the metal was tested) was noted in NbC and TaC. Analysis of the results from the above mentioned studies predicted that the Mo−Re alloy in contact with HfC should offer a promising system. Based on the above mentioned studies, specimens were fabricated from 25 and 50 vol % Mo-40 wt % Re, and 75 and 50 vol % HfC or ZrC by cold pressing and either liquid phase sintering (2490°C for 2 minutes) or solid state sintering (2350°C for 150 minutes) or hot pressing (2150°C for 20 minutes). The resulting microstructure was a uniformly dispersed ceramic phase surrounded by a thin metal film. Strength values for transverse rupture tests on Mo−Re alloy in combination with HfC were 180 ksi, and densities were 93 to 94 percent of theoretical. (auth)

Structure and Phase Studies

Refer also to abstract 45937.

46012 (IS-T-193) YTTRIUM–CARBON PHASE SYSTEM. Paulson, Wayne Marvin (Ames Lab., Iowa). Aug. 1967. Contract W-7405-eng-82. 35p. Dep. CFSTI.

Thesis.

A Y−C phase diagram has been proposed based on thermal, metallographic and x-ray data. The solubility of C in Y increases with increasing temperature to 9.4a/oC at 1500°C. A peritectic occurs at 1558°C and 11a/oC and a peritectoid occurs at 1510°C and 10a/oC. The fcc γ phase melts congruently at 2000°C and 30a/oC and transforms to an ordered γ' phase below 1100°C at 33.3a/oC. A minimum was found in the solidus at 1805°C and 54a/oC. The bct YC_2 transforms to a fcc structure at 1330°C and melts congruently at 2415°C. A miscibility gap with a critical point at 1644°C and 58a/oC was found between γ and YC_2. The solid solution phases δ lies within the miscibility gap and transforms to ϵ at about 1355°C and 57a/oC. A limiting eutectoid occurs at 1320°C and 64a/oC and a YC_2−C eutectic horizontal was found at 2300°C. Alloys between 48a/oC and 62a/oC which were quenched from temperatures above the miscibility gap undergo a shear transformation to a metastable phase. (auth)

46013 (LA-TR-67-73) ORTHORHOMBIC β'-PHASES OF NIOBIUM AND VANADIUM CARBIDES. Aliamovskii, S. I.; Shveikin, G. P.; Gel'd, P. V.; Volkova, N. M. Translated by Helen J. Dahlby (Los Alamos Scientific Lab., N. Mex.) from Zh. Neorg. Khim., 12: 579-82(1967). 11p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

The study of β'-phases in Nb_2C and V_2C is presented. Data from x-ray diffraction analyses are listed. The introduction of small impurities of N_2 and O_2 promotes the rearrangement of the hexagonal lattice of the lower carbides into the orthorhombic. The structures of the orthorhombic β'-phase of Nb_2C and V_2C were determined, and the conditions of stabilizing them are explained. (auth)

46014 STRUCTURE OF SINTERED TUNGSTEN CARBIDE–COBALT ALLOYS. Exner, Hans Eckart; Fischmeister, Hellmut. Arch. Eisenhuettenw., 37: 409-15(May 1966). (In German).

Development of the microstructure of the alloys was observed qualitatively and quantitatively as a function of Co content, initial particle size of the carbide, and sintering conditions. Alloys sintered at temperatures above the melting point of the W–Co–C eutectic contained a single kind of carbide crystals. In addition to the carbide-Co phase boundaries, there were also interfaces of carbide grains, which form three-dimensional structures up to high Co contents. Grain growth takes place by dissolution of small crystals, precipitation of larger crystals, and grain-boundary migration. The carbide grain size in sintered alloys is a function of the particle size in the initial powder, the width of the particle-size distribution and sintering conditions. Growth of the Co layers followed a time law of the form $l - l = k_1 \times t^{\frac{1}{3}}$. The activation energy of both growth processes was calculated as 142,000 ± 25,000 cal/mole and is in agreement with the magnitude of the activation energies for dissolution of WC–Co melts and the diffusion of W in WC carbide. (Rev. Met. Lit.)

46015 STRUCTURE OF SOME ALLOYS IN THE TERNARY Ti–Mo–C SYSTEM. Eremenko, V. N.; Velikanova, T. Ya.; Shabanova, S. V. pp 11-19 of Novye Issled Titan Splavov. Moscow, Nauka, 1965. (In Russian).

Alloys of the Mo_2C–TiC and Mo_3C_2–TiC sections (98.5 at. % Mo_2C + 1.5 at. % C)-(98.5 at. % TiC + 1.5 at. % C) were studied by microstructural and x-ray analyses. The microhardness of the phases and the melting point were determined. A TiC (delta-phase)-base solid solution and Mo_2C (gamma-phase)-base solid solution were detected in the Mo_2C–TiC system. The system is of the peritectic type and the peritectic temperature is 2415 ± 15°C. At 2000°C the solubility of Mo_2C in TiC is 36 mole % (68 wt %). The maximum solubility at 2415 ± 15°C is 58 mole %. The maximum solubility reaches 25 mole %. Only the boundary of the field of delta-solid solutions was investigated for alloys of the section (98.5 at. % Mo_2C + 1.5 at. % C)-(98.5 at. % TiC + 1.5 at. % C). The solubility of Mo_2C in TiC at 2000°C was 40 mole %. The maximum solubility at 2500°C was about 68 mole %. A preliminary phase diagram of the Mo_3C_2–TiC system at temperatures exceeding 2000°C was plotted. Mo_3C_2 forms according to the peritectic reaction liquid + C ⇌ Mo_3C_2 at 2560 ± 20°C and exists in the following two modifications: alpha (fcc lattice, a = 4.27 kX); and eta + (hexagonal lattice, a = 3.0 kX, c = 14.58 kX, c/a = 4.86). The temperature of the transformation alpha ⇌ eta is 2200°C. There is a continuous series of alpha (delta)-solid solutions above 2000°C. Below 2200°C the alpha (delta)-solid solution in alloys containing less than 39 mole % TiC undergoes an alpha → eta polymorphic transformation. At 2100°C the solubility of eta Mo_3C_2 in TiC is 66.6 mole %. (Rev. Met. Lit.)

46016 HIGH-TEMPERATURE MASS SPECTROMETRIC STUDY OF THE SYSTEM NEODYMIUM–CARBON. De Maria, G.; Balducci, G.; Capalbi, A.; Guido, M. (Univ., Rome). Proc. Brit. Ceramic Soc., No. 8, 127-36(June 1967).

The gaseous phase in thermodynamic equilibrium with the condensed neodymium–carbon system was investigated by means of the combined Knudsen-cell–mass-spectrometric technique at 1950 to 2160°K. The gaseous dicarbide molecule NdC_2 was identified and its dissociation energy was evaluated by means of the second-law and third-law methods. Study of the pressure-independent reaction Nd(g) + 2C(s) → NdC_2(g), combined with the partial heat of sublimation of carbon to C_2(g), was used to obtain the following values for the energy of the Nd–C_2 bond: ΔH_0° = 146 ± 5 kcal/mole^{-1} (second-law value) and ΔH_0° = 149 ± 5 kcal/mole^{-1} (third-law value). The atomization energy of the molecule is 291 ± 5 kcal.mole^{-1} as obtained by means of the third-law method. (auth) (UK)

46017 STUDIES OF Gd–Te SYSTEM. Zargaryan, V. Sh.; Abrikosov, N. Kh. (Inst. of Metallurgy, Moscow). Izv. Akad. Nauk SSSR, Neorg. Mater., 3: 769-76(May 1967). (In Russian).

Fused polycrystalline samples of the compounds GdTe, Gd_3Te_4, Gd_2Te_3, Gd_4Te_7, $GdTe_2$, Gd_3Te_5, and $GdTe_3$ and samples the compositions that lie in the region of solid solution between Gd_3Te_4 and Gd_2Te_3; namely $Gd_{2.86}Te_4$, $Gd_{2.8}Te_4$, $Gd_{2.84}Te_4$, $Gd_{2.78}Te_4$, $Gd_{2.7}Te_4$, $Gd_{2.69}Te_4$, and $Gd_{2.68}Te_4$, were produced. By thermal and microstructural analytical methods, constitution diagrams of the system Gd–Te were constructed. The compound GdTe melts with a clear maximum of 1,825 ± 15°C. It forms a eutectic with Gd at 3 at. % Te melting at 1,290°C. The compounds with the composition Gd_3Te_4, Gd_2Te_3, Gd_4Te_7, $GdTe_2$, Gd_3Te_5, and $GdTe_3$ are formed by peritectic reactions at 1255, 1215, 1190, 1000, 920, and 835°C, respectively. $GdTe_3$ forms a degenerate eutectic with Te at 450°C. The electroconductivity and the thermal emf were measured at 300 to 1,300°K for the Gd–Te systems. Gd_2Te_3, Gd_4Te_7, and $GdTe_2$ act as impure semiconductors with a wide forbidden zone of 0.74, 0.5, and 0.4 eV, respectively. In the solid solution region of Gd_3Te_4–Gd_2Te_3 a gradual transition from Gd_2Te_3, having semiconductor properties, to Gd_3Te_4, having metallic properties, was found. (tr-auth)

46018 CONTRIBUTION TO THE STUDY OF THE OXIDATION OF Zr AND OF THE DIFFUSION OF O_2 IN THE OXIDE AND IN THE METAL. PART III. Debuigne, Jean Metaux (Corros.-Ind.), 42: 235-58(June 1967). (In French).

A precise study of the diffusion of O_2 into Zr necessitates a detailed knowledge of the physical and the physicochemical characteristics of solid solutions of O_2 in Zr and of the characteristics of oxide films formed on the metal. The x-ray diffraction study of homogeneous solid solutions indicates that the interstitial O_2 atoms are distributed in an ordered manner between the octahedral sites of the hexagonal lattice of a Zr. The adherence of the oxide film to the surface of the metal and the mode of release of the mechanical stresses developed at the metal-oxide interface are conditioned partially by the mechanical characteristics of the metallic zone highly enriched in O_2 and adjacent to the oxide. The examination of the profile of the microhardness curves obtained in the metallic zone subjacent to the oxide shows that the decrease of the hardness as a function of the distance to the metal-oxide interface is not made in a regular manner but in steps. It was not possible to show an eventual dependence of the diffusion coefficient O_2 on the concentration of the O_2 or an influence of the ordered arrangement of the O_2 atoms on its diffusion. The behavior of Zr in air was studied simultaneously with the behavior of this metal in pure O_2. The essential difference is in the change of the oxidation kinetics observed in air at the end of a relatively short time, function of the temperature and purity of the metal and connected with the peeling of the oxide. (tr-auth)

46019 CONSTITUTION OF BINARY MOLYBDENUM–CARBON ALLOYS. Rudy, E.; Windisch, St.; Stosick, A. J.; Hoffman, J. R. (Aerojet-General Corp., Sacramento, Calif.). Trans. Met. Soc. AIME, 239: 1247-67(Aug. 1967).

The binary alloy system Mo-C was investigated by means of x-ray, metallographic, thermoanalytical, and melting-point techniques on chemically analyzed specimens. The system is characterized by three congruently melting, intermediate phases, Mo_2C, ηMoC_{1-x}, and αMoC_{1-x}, of which only Mo_2C is stable at temperatures below 1650°C. Substoichiometric (<32.5 at. % C) Mo_2C undergoes a homogeneous sublattice order-disorder transformation at temperatures of approximately 1400°C, whereas hyperstoichiometric compositions undergo a discontinuous phase change. The order-disorder transitions in the Me_2C phases are discussed in terms of the structural changes involved in the transformation processes and the absence of long-range sublattice coherency in stoichiometric or hyperstoichiometric compositions attributed to the impossibility of obtaining long-range order in a linear chain of alternating carbon atoms and vacancies. From the experimental phase relationships and the known thermodynamic data for Mo_2C, limits for the free energies of formation for the high-temperature phases ηMoC_{1-x} and αMoC_{1-x} are derived and found to be in good agreement with data previously obtained from phase equilibria in ternary metal-C systems. (auth)

46020 IRRADIATION DAMAGE TO ALUMINUM OXIDE EXPOSED TO 5 x 10^{21} FAST NEUTRONS/CM^2. Keilholtz, G. W.; Moore, R. E. (Oak Ridge National Lab., Tenn.). Nucl. Appl., 3: 686-91(Nov. 1967). (ORNL-P-3093).

The effects of neutron irradiation on polycrystalline α-Al_2O_3 were investigated. The specimens were translucent solid cylinders of 99.8% of theoretical density density with an average grain size of 25 μm. Fast (>1 MeV) neutron exposures ranged from 0.6 to 5.2 × 10^{21} n/cm^2 where the thermal-to-fast flux ratio varied from 1.6 to 1.1. Temperatures of the specimens were calculated to range from 300 to 600°C. Grain-boundary separation was observed when the neutron dose (>1 MeV) was approximately 2.3 × 10^{21} n/cm^2, and it became progressively worse with increasing neutron dose. Extensive fracture was observed in specimens exposed to doses above 3 × 10^{21} n/cm^2 (>1 MeV), but there was virtually no fracturing of samples exposed to doses less than 2 × 10^{21} n/cm^2. Volume of the specimens increased as the neutron dose increased, but the volume as calculated from the lattice parameters, which increased in specimens exposed to a neutron dose of 0.7 × 10^{21} n/cm^2, decreased slightly with additional radiation. Above 0.7 × 10^{21} n/cm^2, the a parameter remained constant while the c parameter decreased. It is suggested that grain-boundary separation, which causes the fracturing of the specimens, is produced by an anisotropic expansion of the crystals produced by defect agglomerates which are too large to affect the lattice parameter measurements. (auth)

46021 ZIRCONIUM–VANADIUM–BORON SYSTEM. Cherkashina, N. V.; Feodorov, T. F.; Shamrai, F. I. pp 421-8 of Vyso-

kotemperaturn Neorgan Soedineniya. Kiev, Nauk Dumka, 1965. (In Russian).

Alloys of the ZrB_2-VB_2 and $Zr-VB_2$ sections in the Zr–V–B system were investigated by x-ray analysis and studies of the oxidability. Alloys of the ZrB_2-VB_2 section are characterized by a low mutual solubility of the components and consist of ZrB_2 and VB_2. The addition of VB_2 to ZrB_2 reduced its oxidation resistance. The alloys of the $Zr-VB_2$ section that contain more than 50 mole % Zr have a compound with a fcc lattice and spacings 4.63 kX (alloys prepared by hot pressing) and 4.654 kX (alloys sintered in a TW-2 furnace) in the structure. The alloys of the $Zr-VB_2$ section are very brittle and at 1200°C become completely oxidized. (Rev. Met. Lit.)

46022 SELF-DIFFUSION OF URANIUM IN URANIUM MONOCARBIDE. Lindner, R.; Riemer, G.; Scherff, H. L. (CCR-EURATOM, Ispra, Italy). J. Nucl. Mater., 23: 222-30(1967).

Self-diffusion of U in monocrystalline and cast material of UC of slightly hypostoichiometric and hyperstoichiometric compositions has been measured in the temperature range 800 to 2100°C, using the technique of alpha energy degradation. Nearly identical activation energies of about 30 kcal/mole were found for both materials at temperatures up to 1600°C for the 4.68% and 1400°C for the 4.83% material respectively. At higher temperatures, however, different values of the activation energy were observed: 70 ± 5 kcal for the hypostoichiometric and 90 ± 6 kcal for the hyperstoichiometric UC. (auth)

Radiation Effects

Refer also to abstract 46870.

46023 (AD-645535) RADIATION EFFECTS ON DIELECTRIC MATERIALS. Report No. 5 (Final), July 1–September 30, 1966. Colwell, J. F.; DeMichele, D. W.; Overmeyer, R. F. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Dec. 1966. Contract DA-28-043-AMC-01412(E). 57p. (ECOM-01412-F). CFSTI.

A detailed description of the techniques and equipment employed in the ion-implantation process is presented. Results of high-energy electron irradiation of a Mylar capacitor with ion-implanted electrodes are compared with the response of a control sample. The ion-implanted electrodes exhibit better carrier injection than conventional foil electrodes. Transient radiation effects data from irradiation of a monolithic ceramic capacitor and two glass capacitors are included. One of the glass capacitors contained a semicrystalline dielectric with very high dielectric constant. The transient radiation effects in Mylar versus temperature appear to fit a band model for the conduction process in which a continuous distribution of carrier traps is located in the forbidden zone and one sign of carrier is immobilized. An examination of the energy loss processes of moderately fast electrons in insulators indicates that from 15 to 3 eV the energy loss is primarily to excitons whereas energy loss to optical and acoustical phonons occurs down to thermal energies. (TAB)

46024 (AD-650120) CHARACTERISTICS OF PULSED LASER CRYSTALS AS A FUNCTION OF GAMMA IRRADIATION. Final Scientific Report (Part I), October 8, 1965–December 7, 1966. Cobb, Grover C.; Collins, Williams C.; Davis, William R.; Gravely, Benjamin T.; Moss, Marvin K. (North Carolina State Univ., Raleigh. School of Physical Sciences and Applied Mathematics). Contract DA-01-021-AMC-13339(Z). 50p. CFSTI.

A study of the laser characteristics of CaWO4 : Nd(3+), CaMoO4 : Nd(3+), LaF3 : Nd(3+), LaF3 : Pr(3+), CaMoO4 : Nd(3+) : Tm(3+), Y3Al5O12 : Nd(3+), and Y3Al5O12 : Nd(3+) : Cr(3+) was made as a function of gamma irradiation. In particular, the Co60 gamma radiation produced absorption bands were studied for their effects relating to fluorescent efficiency. CaWO4 : Nd(3+) and CaMoO4 : Nd(3+) showed very little gamma induced center band structure. The efficiency of CaWO4 : Nd(3+) decreased substantially as a function of gamma dose; however, the efficiency of CaMoO4 : Nd(3+) was only slightly decreased by a total dose of 2 MR. The doped LaF3 crystals showed a substantial gamma induced center band structure. However, only the LaF3 : Pr(3+) exhibited interesting laser characteristics. The efficiency of Y3Al5O12 : Nd(3+) : Cr(3+) was increased significantly by gamma irradiation, first appearing at a dose level of 2,000 R and continuing to a total dose of 15,000 R. At a dose of 20,000 R the overall efficiency had decreased slightly. (auth) (TAB)

46025 (BNWL-CC-761) REACTOR FUELS AND MATERIALS DEVELOPMENT PROGRAMS FOR FUELS AND MATERIALS BRANCH OF USAEC DIVISION OF REACTOR DEVELOPMENT AND TECHNOLOGY. Quarterly Progress Report, April–June 1966. Albaugh, F. W.; Bush, S. H.; Cadwell, J. J.; deHalas, D. R.; Worlton, D. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 1966. Contract AT(45-1)-1830. 137p. Dep. CFSTI.

Topics discussed include fast reactor oxides and nitrides, nuclear ceramics, nuclear graphite, basic swelling studies, radiation damage to reactor metals, ATR gas loop operation and maintenance, metallic fuels, and nondestructive testing research. (D.C.C.)

46026 (N-67-18414) EFFECT OF RADIATION ON THE STABILITY OF SILICON NITRIDE AND METAL NITRIDE SEMICONDUCTOR FET DEVICES. Quarterly Report, July 1–October 1, 1966. Totah, R. P. (Hughes Aircraft Co., Newport Beach, Calif.). Contract NAS8-18003. 42p. (NASA-CR-82020). CFSTI.

Silicon nitride films were prepared and evaluated as capacitor dielectrics. Etch rate enhancement of the Si_3N_4 films due to irradiation are discussed along with radiation test equipment set-up, and evalution of the test procedures. (STAR)

46027 (NUMEC-3432-35) IRRADIATION TESTING OF PuO_2-UO_2 FUELS. Quarterly Progress Report, April 1, 1967–June 30, 1967. (Nuclear Materials and Equipment Corp., Apollo, Pa.). Sept. 1967. Contract AT(30-1)-3432. 14p. Dep. CFSTI.

The irradiation program of instrumented capsules containing PuO_2-UO_2 fuels having compositions of interest for fast breeder reactors and for Pu recycle in thermal reactors is described. Five capsules to be irradiated for periods ranging from 10,000 to 100,000 MWd/t have been fabricated. The objectives of the program are: evaluate the performance of fuel elements from coprecipitated PuO_2-UO_2 and pellets prepared by the mechanical mixing of the component powders; evaluate the differences in performance due to differences in pellet stoichiometry; determine the effect on performance of relatively gross inhomogeneities from incomplete powder blending; and observe performance of fuel elements formed by vapor cementation with W of spherical particles composed of PuO_2-UO_2. (auth)

46028 (ORNL-TM-1799) AN IRRADIATION EXPERIMENT TO STUDY THE COMPATIBILITY OF BeO WITH GRAPHITE AT 1500°C. PART II. OPERATION AND POSTIRRADIATION EVALUATION. Brandon, C. A.; Cuneo, D. R.; Engle, G. B.; Long, E. L. Jr. (Oak Ridge National Lab., Tenn.). Oct. 1967. Contract W-7405-eng-26. 33p. Dep. CFSTI.

An irradiation experiment was conducted to develop advanced gas cooled reactor technology. The lapped surfaces of BeO and graphite rings were maintained in intimate contact during 9 months exposure at 1280 to 1500°C to 1×10^{21} neutrons/cm^2, E > .18 MeV. Postirradiation examination of the contact surfaces indicated no chemical reaction had occurred. These rings and other components of the irradiated assembly were examined for ^{6}Li. A massive BeO core (1-in. diam by 4.5-in. length) was found to have retained a major portion of the ^{6}Li generated within it during the irradiation. No gross radiation induced physical damage was observed in either BeO or graphite components. The physical changes observed were in general agreement with previously reported results. (auth)

46029 (UCRL-Trans-10131) STUDIES ON THE IRRADIATION OF CERAMIC NUCLEAR FUELS. Miron, I. Translated for Univ. of California, Lawrence Radiation Lab., Livermore, from Stud. Cercet. Fiz., 17: 1133-8(1965). 14p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

The study of irradiation effects on ceramic fuels at maximum power output is presented. Studies of radiation effects on UO_2 includes: susceptibility to cracking due to temperature gradients and thermal shocks; liberation of part of the gaseous fission products; expansion which results from the formation of fission products; structural modifications and changes in chemical composition; and the variation in thermal conductivity. (auth)

46030 THE KINETICS OF THE OXIDATION OF IRRADIATED URANIUM DIOXIDE SPHERES IN DRY AIR. Harrison, K. T.; Padgett, C.; Scott, K. T. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Mater., 23: 121-38 (Aug. 1967).

Apparatus is described for the remote thermogravimetry of irradiated UO_2 spheres. The results of isothermal oxidation in dry air at temperatures between 320 and 380°C are discussed. The oxidation is best described as a first order reaction occurring in two stages, the rate constant being higher for the second stage. The rate curves do not fit those predicted by any single model for the oxidation mechanism, possibly because of the complicating effects of grain boundaries. Neutron irradiation up to 9% burnup of all U atoms was not found to alter the oxidation mechanism fundamentally but produced a general slowing down of reaction rates. Thus the Arrhenius activation energy for the second stage increased from ~15 kcal/mole for unirradiated UO_2 to ~25 kcal/mole at ~8.5% burnup. (auth)

46031 THE RELEASE OF SOME NON-GASEOUS FISSION PRODUCTS FROM CaF_2, UO_2, AND ThO_2. Matzke, Hj. (Technical Univ., Brunswick). J. Nucl. Mater., 23: 209-21(1967).

The release of certain non-gaseous fission products (Br, Rb, Cs from ion-bombarded UO_2 and ThO_2 sinters; I, Te, Ba/La from fission-recoil labelled CaF_2 single crystals) from materials with the fluorite structure was studied. The concentration of Br, Rb, and Cs was varied by using two ion doses. In most experiments, several mass transport processes contributed to the release. Release compatible with volume diffusion was found for Rb and Cs in ThO_2 at the lower bombardment dose of 3×10^{13} ions/cm^2; release occurred at temperatures similar to those for fission gas diffusion and yielded activation enthalpies of about 100 ± 7 kcal/mole, similar to those for fission gas diffusion or U self-diffusion. All other releases were complex. In contrast to gas release work, no trapping was found at the high bombardment dose of 1.5 to 2×10^{16} ions/cm^2: Release of Br was not affected and release of Rb and Cs occurred at lower temperatures than the release at lower dose. If most of the Br or Rb was near the surface of ThO_2 sinters, an enhanced release at low temperatures was observed. Release of Br from ThO_2 was faster when the samples were annealed in hydrogen than when annealed in air. All this indicates that various factors can influence the release of these non-gaseous fission products including surface reactions (e.g. vaporization), the location of the diffusing ion with respect to the surface, the concentration of the diffusing species and the presence of radiation damage. (auth)

Plastics and Other Materials

Refer also to abstracts 45208, 46023, 46025, 46963, and 46954.

46032 (BNWL-489) EFFECTS OF SOME PROCESS TEMPERATURES ON RADIATION INDUCED CONTRACTION OF GRAPHITE. Cox, J. H. Jr.; Marek, R. W.; Parker, W. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1967. Contract AT(45-1)-1830. 16p. Dep. CFSTI.

The dimensional change that occurs during the thermal processing of graphite and the subsequent dimensional change that occurs when graphite is irradiated has been explored. A lower rate of rise to the graphitization temperature yielded a slight improvement in dimensional stability under neutron irradiation for the transverse orientation; however, in the parallel orientation there was no appreciable effect of graphitization rate on dimensional stability. A second series of samples was used to demonstrate the degree to which binder heat treatment influences radiation induced dimensional changes. The filler for the formulation was graphitized to 2900°C and then mixed with a graphitizable binder. Subsequently, the samples were heat treated to temperatures appropriate for a broad range of crystallite development in the binder phase. Differences in radiation induced contraction can be attributed to the binder phase. Unlike a system in which all constituents have the same graphitization temperature, this series does not show a uniform increase in contraction rate with decreasing graphitization temperature. There is little effect of heat treatment temperature down to 2000°C; at heat treatment temperatures below 2000°C there is a sharp increase in contraction rate for both orientations. (auth)

46033 (BNWL-502) RADIATION STUDIES ON GRAPHITE WITH CONTROLLED PROCESSING. Cox, J. H. Jr. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 1967. Contract AT(45-1)-1830. 22p. Dep. CFSTI.

The effect of graphitization temperature, crystallite orientation, impregnation, and density on the dimensional stability of graphite under neutron irradiation is described. The irradiations in a Hanford test facility accumulated exposures up to 2×10^{21} nvt (E > 0.18 MeV) at temperatures in the range 550 to 700°C. The investigation of the effect of graphitization temperature involved five series of samples, with final processing temperatures of 700 to 3000°C. Increased processing temperature resulted in an appreciably lower radiation induced contraction rate; however, the most pronounced effect was found at temperatures below 2500°C. In graphites identical except for crystallite orientation a linear relationship was found between coefficient of thermal expansion values and contraction rates. A higher coefficient of thermal expansion resulted in a lower contraction rate. In graphites identical except in impregnant level, increasing the impregnant level above a threshold, 16% for the series studied, resulted in the contraction rate increasing with impregnant level. Increasing the density of graphite did not affect the radiation induced dimensional changes. (auth)

46034 (BNWL-CC-399) RADIATION-INDUCED DIMENSIONAL CHANGES OF GRAPHITE: EFFECT OF SAMPLE SIZES LESS THAN ONE-HALF INCH DIAMETER. Helm, J. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Dec. 1965. Contract AT(45-1)-1830. 11p. Dep. CFSTI.

Six capsules were irradiated in the ETR to determine the effect of sample size on the dimensional behavior of graphite under neutron irradiation. Sample temperatures ranged from 400 to 800°C and the maximum neutron exposure was about 4×10^{21} nvt, E > 0.18 MeV. For samples having equivalent diameters between $^{11}/_{32}$ in. and $^{17}/_{32}$ in., there appears to be no effect of sample size on dimensional behavior. However, the $^1/_8$ in. diameter samples show a decided effect with the transverse samples showing somewhat more and the longer parallel samples less contraction than the other sizes. (auth)

46035 DEFORMATION CHARACTERISTICS OF NUCLEAR GRADE GRAPHITES. Gillin, L. M. (Cambridge Univ., Eng.). J. Nucl. Mater., 23: 280-8(1967).

The compression properties of Nuclear Grade type A and isotropic graphite are reported for the temperature range 20 to 2200°C in both air and in a vacuum better than 10^{-4} Torr. Both graphites show an anomalous increase in strength at temperatures around 2000°C which is associated with some plasticity. A mechanism is proposed for this increased strength which is based on the relief of internal stresses at tilt boundaries in grist particles. (auth)

46036 THE SOLID-SOLUBILITY OF CARBON IN Nb AND Nb-RICH Nb-HF, Nb-Mo, AND Nb-W ALLOYS. Taylor, A.; Doyle, N. J. (Westinghouse Research Labs., Pittsburgh). J. Less-Common Metals, 13: 511-29(Nov. 1967).

By comparison with O_2 and N_2, the amount of C which can be taken into interstitial solid solution in Nb and Nb-rich Nb–Hf, Nb–Mo and Nb–W alloys is very small. Over the temperature range 1600 to 2180°C the solid-solubility limit of C in Nb is about 0.55 at. %, and this is reduced by the alloying elements Hf and Mo. At 2000°C the solid-solubility limit of C in 95 Nb 5 Hf (the numbers being at. %'s) is less than 0.2 at. %. It is probably less than 0.1 at. % C at 2000°C in the alloy 95 Nb 5 Mo. However, W additions in amounts up to 10 at. % do not seem materially to influence the solid-solubility of C, which remains at about 0.55 at. %, as in the case of Nb. In the Nb–Hf–C system, below 2 at. % Hf, the phase in equilibrium with α-Nb solid solution is Nb_2C, switching over to the extensive (Nb,Hf)C phase above 2 at. % Hf. On the other hand, Nb_2C is in equilibrium with α-Nb phase containing up to 48 at. % Mo, above which the equilibrium switches over to α-Nb + (Nb,Mo)C. The same holds true for the corresponding Nb–W–C system, the switchover now occurring at 40 at. % W, approximately. It is highly probable that the extensive fcc (Nb,Hf)C, (Nb,Mo)C and (Nb,W)C phases contain lattice vacancies in lieu of C atoms when the metal content exceeds 50 at. %. (auth)

46037 EFFECTS OF THERMAL NEUTRONS ON THE PROPERTIES OF OPTICAL GLASS. I. Prasada Rao, Chaganti Nagendra (Univ., Paris). Rev. Opt., 45: 393-403(Sept. 1966). (In French).

Aspects of the action of radiation on matter, particularly of neutrons, are briefly reviewed. The history of the irradiation of glass is outlined; the effect of compaction in irradiated glass is considered with respect to observations and interpretation. Absorption bands in irradiated glass and reduction by the introduction of Ce are discussed. The preparation and irradiation of samples, including ordinary crown, borosilicate crown, gravure, light crown, heavy crown, special Ba crown, baryte special flint, dense flint, and extra dense flint, are outlined. Techniques of measurements on irradiated samples for density, refractive index, and spectral absorption are given, together with a list of precautions made necessary by the activity of the samples. (BBB)

46038 EFFECTS OF THERMAL NEUTRONS ON THE PROPERTIES OF OPTICAL GLASS (CONCLUSION). Prasada Rao, Chaganti Nagendra (Univ., Paris). Rev. Opt., 45: 441-64 (Oct, 1966). (In French).

Experimental results from a study of neutron irradiation of glass samples are presented. Effects of atomic displacement are disparate; electronic modifications are categorized for silica, borate, Pb, and complex glasses (Pb silicates, other silicates, borosilicates, and alkali-free borosilicates). The role of Ce and decoloration phenomena as a function of time are discussed. Residual radioactivity is not a simple function of the composition; the ir spectrum is not affected by doses between 10^{16} and 10^{18} neutrons/cm^2. Ionizing effects are more uniform than displacement effects, and are independent of the agent used. Glasses without Ce darken greatly; polarizable ions (Pb(II), Ti(IV) resist darkening. Darkening occurs from faults, either inherent or radioinduced. Use of Ce glass in the nuclear industry should be based on the type of radiation a glass is to undergo and the optical qualities desired, which may be developed easily in practice but are difficult to explain theoretically. (BBB)

PHYSICS (GENERAL)

Astrophysics

Refer also to abstracts 46134, 46135, and 46350.

46039 (AD-647890) CHERENKOV LIGHT FROM EXTENSIVE AIR SHOWERS. Final Scientific Report, January 1, 1963-December 31, 1966. Porter, Neil A. (University Coll., Dublin (Ireland). Dept. of Physics). Contract AF-EOAR-80-63. 133p. (AFOSR-67-0609). CFSTI.

An optical Cherenkov system was used to set upper flux limits for gamma rays from possible sources, in the energy region 10^{13} eV. 13 possible sources were examined: the quasars 3C 9, 3C 48, 3C 147, 3C 196, 3C 273, 3C 286; the Crab Nebula, magnetic variables HD71866 and 53 Cam; and the Galaxies Cygnus A, M31, NGC4472 and 1607 + 26. The quasar results when summed show a slight positive effect; approaching significance for 3C 147. Non-quasar sources showed no effect. A theory of and angular distribution of light from showers is discussed, and an image intensifier system for shower photography described. A wide-band receiver was used to detect pulses in coincidence with shower particles. The rate of pulses indicates significant decoherence at 70 Mc. Correlation was found between optical Cherenkov and radio pulses. Preliminary results are presented for a long distence coincidence experiment, using pure radio detection. (auth) (TAB)

46040 (N-67-18354) SOME EFFECTS OF NUCLEAR FORCES ON NEUTRON STAR MODELS. Tsuruta, Sachiko; Cameron, A. G. W. (National Aeronautics and Space Administration, New York. Goddard Inst. for Space Studies). [1965]. 70p. (NASA-TM-X-57347). CFSTI.

Two composite equations of state were used in investigating the structure of neutron (or hyperon or baryon) stars; these are based upon two forms of the neutron-neutron potential. In one form repulsive forces come in quickly at greater than nuclear densities; in the other form the repulsive forces come in slowly. In the former case the maximum stable mass of a neutron star is about two solar masses; whereas in the latter case it is only about one solar mass. This probability represents a measure of the basic uncertainty in the properties of neutron star models due to lack of knowledge of nuclear forces. The maximum central density of a stable configuration is similarly uncertain; this density probably lies in the range 10^{15} to 10^{16} grams/cm^3. Details of many of the neutrons star models calculated are summarized and discussed. (auth) (STAR)

46041 (N-67-18355) ASTROPHYSICAL EVIDENCE FOR THE DIRECT ELECTRON-NEUTRINO WEAK INTERACTION. Chin, Chao-wen; Chiu, Hong-yee; Stothers, Richard (National Aeronautics and Space Administration, New York. Goddard Inst. for Space Studies). [1965]. 42p. (NASA-TM-X-57356). CFSTI.

Observational evidence exists that central stars of planetary nebulae are evolving into white dwarfs. However, a gap in the stellar population appears between the faintest central stars (100 $L_\odot$) and the brightest white dwarfs (1 $L_\odot$). Theoretical models of superluminous white dwarfs (Gap stars) are constructed with and without the inclusion of neutrino emission processes. Neutrino emission is known to speed up stellar evolution. The evolution of stars in the mass range 0.7 $M_\odot$ to 1.1 $M_\odot$ was found to be accelerated by a factor of 10 to 100 if plasma neutrino emission is included. The larger Gap stars can be identified by their blue color. An upper limit to their evolution time is obtained from a variety of observational arguments. This limit is 5×10^8 years as compared with theoretical lifetimes of 2×10^5 years with neutrino emission and 2×10^6 years without it. From these results it is concluded that the plasma neutrino energy loss rate roughly reproduces the astronomical data, and the weak interaction coupling constant for the $(e\nu_e)$ $(e\nu_e)$ interaction has a lower limit close to the currently accepted value. There is also evidence that neutrino emission may be accelerating evolution in central stars. (STAR)

46042 (N-67-18356) GRAVITATIONAL COLLAPSE AND WEAK INTERACTIONS. Arnett, W. David (National Aeronautics and Space Administration, New York. Goddard Inst. for Space Studies). [1966]. 102p. (NASA-TM-X-57354). CFSTI.

The behavior of a massive star during its final catastrophic stages of evolution has been investigated theoretically, with particular emphasis upon the effect of electron-type neutrino interactions. The methods of numerical hydrodynamics, with coupled energy transfer in the diffusion approximation, were used. Gravitational collapse initiated by electron capture and by thermal disintegration of nuclei in the stellar center is examined, and the subsequent behavior does not depend sensitively upon which process causes the collapse. (auth) (STAR)

46043 (N-67-18360) EVOLUTION OF THE SUN. Chiu, Hong-yee (National Aeronautics and Space Administration, New York. Goddard Inst. for Space Studies). [1965]. 31p. (NASA-TM-X-57357). CFSTI.

The various stages and processes in the evolution of the Sun are described. The discussion covers the formation of the Sun and planets, the Hertzsprung-Russell diagram which is used to discuss the history and future evolution of the Sun, the condensation of the solar nebula to form the proto-Sun, the Sun as a nuclear furnace, hydrogen exhaustion of the Sun and transition into a red giant, helium reaction and ultimate fate of the Sun, and finally the Sun's evolution into a planetary nebula and then a white dwarf. (STAR)

46044 (JPRS-42567) SOLAR WINDS AND INTERPLANETARY MAGNETIC FIELDS. Mustel', E. R. Translated from Priroda, 56: No. 7, 13-23(1967). 20p. (TT-67-33195). CFSTI.

Consideration is given to the source, structure, and distribution of interplanetary magnetic fields. Properties of the solar wind that include motion, velocity, particle concentration, composition, and temperature are discussed. Information is also included on various aspects of solar magnetic fields and the relationship between solar plasma and geomagnetic activity. (J.H.M.)

46045 OBSERVATIONS OF SMALL GALAXIES WITH THE 21-CM RAY OF HYDROGEN. Bottinelli, Lucette; Gouguenheim, Lucienne; Heidmann, Jean; Heidmann, Nicole (Observatoire de Paris, Meudon, France). Compt. Rend., Ser. A and B, 265: 105-7 (July 3, 1967). (In French).

The results of measurements for 30 of the 55 small galaxies observed by the 21-cm ray with the Nancay radiotelescope are given. (tr-auth)

46046 X RAYS FROM SOURCES 3C 273 AND M 87. Friedman, H.; Byram, E. T. (Naval Research Lab., Washington, D. C.). Science, 158: 257-9(Oct. 13, 1967).

An x-ray survey of the Virgo region revealed signals from the directions of 3C 273 and M 87. Three other x-ray sources appear in the region scanned, but do not fit any known radio sources. The x-ray flux (1 to 10 angstroms) from the direction of 3C 273 is about 1000 times weaker than from the strongest x-ray source, Sco XR-1. If the source is located at the cosmological distance of 500 megaparsecs, the x-ray luminosity is 7.3×10^{45} ergs/sec. The x-ray luminosity of M87 is 1.5×10^{43} ergs/sec. (auth)

46047 EFFECTS OF AN INTERVENING GALAXY ON THE RADIATION FROM VERY DISTANT OBJECTS. Wagoner, Robert V. (California Inst. of Tech., Pasadena). Astrophys. J., 149: 465-80(Sept. 1967).

The possibility of using the presence of an intervening galaxy to obtain information about the distance of a source of radiation is examined. The probability that photons received from a distant object have passed near enough to a galaxy to be significantly modified is computed and found to be appreciable for cosmological redshifts $\gtrsim 1$. Various effects of the galactic matter on the beam are calculated, using the observed properties of nearby galaxies. Included are Faraday rotation, 21-cm absorption, total optical scattering and absorption, and optical absorption lines. If these features are not present in the expected fraction of large redshift sources, then either (a) galaxies of moderate redshift (assumed cosmological) are much different than those nearby or (b) the sources are not at cosmological distances. (auth)

46048 STUDIES OF EXTRAGALACTIC NEBULAE. III. VELOCITY STRUCTURE IN THE NUCLEUS OF NGC 4486. Walker, Merle F.; Hayes, Sethanne (Univ. of California, Santa Cruz). Astrophys. J., 149: 481-6(Sept. 1967).

Analysis of all available plate material does not confirm the emission-line structure in the nucleus reported by Osterbrock. The structure is similar to that observed in the nuclei of NGC 1068 and NGC 4151. (auth)

46049 STUDIES OF EXTRAGALACTIC NEBULAE. IV. PRELIMINARY SPECTROSCOPIC OBSERVATIONS OF NGC 4258. Chincarini, Guido; Walker, Merle F. (Univ. of California, Santa Cruz). Astrophys. J., 149: 487-94(Sept. 1967).

Spectroscopic observations were obtained in P. A. = 148° and P. A. = 58° near the major and minor axes of NGC 4258, respectively. The observations in P. A. = 148° show the presence of a velocity maximum at a distance of about 6″ from the center, followed by a very pronounced minimum at about 16″, after which the curve rises to a second maximum at about 40″ from the center.

In P. A. = 58° the velocity curve is generally bow-shaped, confirming the presence of pronounced noncircular motions. No satisfactory model of the observed motions has been found. In the nucleus, an emission cloud measuring 9.4″ × 5.8″ (300 × 186 pc) was detected. This cloud has about the same size and mass as the nuclear clouds in NGC 1068 but, unlike those clouds, has no kinetic energy with respect to the surrounding material and has very low turbulent energy; the turbulence within the cloud is much lower than in the surrounding material. (auth)

46050 INFRARED-LINE EMISSION FROM PLANETARY NEBULAE. Delmer, Thomas N. (Univ. of California, San Diego); Gould, Robert J.; Ramsay, William. Astrophys. J., 149: 495-516 (Sept. 1967).

The general physical processes are considered which determine the intensities of infrared emission lines resulting from magnetic dipole transitions between fine-structure levels in certain abundant ions. Ionization equilibrium and fine-structure level population are discussed. Radiative recombination is treated in some detail in an appendix where general results are given for averaged recombination Gaunt factors and for approximate intensities of helium recombination line intensities. By means of the quantum defect method, some important collision strengths for fine structure transitions are calculated. On the basis of optical data, estimates are given of the expected infrared-line intensities from nine bright planetary nebulae. There are a number of lines from these planetaries which should have intensities in the range of 10^{-18} to 10^{-16} W/cm^2 and which should be observable from below the atmosphere through the 8 to 14- and 17 to 24-μ windows. Improved estimates are given of the expected thermal bremsstrahlung radio emission from these nebulae, with the assumption that they are optically thin to radio radiation; comparison with radio observations indicates generally satisfactory agreement with these calculations of radio emission. (auth)

46051 THE DYNAMICAL STATE OF THE INTERSTELLAR GAS AND FIELD. II. NONLINEAR GROWTH OF CLOUDS AND FORCES IN THREE DIMENSIONS. Parker, E. N. (Univ. of Chicago). Astrophys. J., 149: 517-34 (Sept. 1967).

The growth of the two-dimensional instability of a gas in a gravitational field g confining a horizontal magnetic field B is followed into the nonlinear regime to provide an illustration of the formation of discrete gas clouds from a more uniform medium. A shock forms as the gas falls together, dissipating the energy and making the process irreversible. The effective force field of an element of gas (suspended on the lines of force of a horizontal magnetic field) is calculated in three dimensions. The force field is made up of an attractive force of the same form as gravity but stronger by the factor g^2/GB^2 and a force which extends undiminished along the lines of force passing near the element of gas. The latter dominates the former at large distances and is attractive on the lines of force through, and above and below, the element of gas, and repulsive along the lines of force passing beside the element of gas. The over-all effect, is a strong attraction, accompanied by vigorous streaming of gas both toward and away from an established cloud. Clouds are expected to accumulate gas in such a way as to increase their vertical dimension relative to the transverse dimension g × B. (auth)

46052 THE DYNAMICAL STATE OF THE INTERSTELLAR GAS AND FIELD. III. TURBULENCE AND ENHANCED DIFFUSION. Parker, E. N. (Univ. of Chicago). Astrophys. J., 149: 535-52 (Sept. 1967).

The dynamical instability of the interstellar gas, caused by the galactic cosmic rays and magnetic field, is examined for the purpose of gaining a more detailed understanding of the phenomenon. It is shown that a tissue of field, formed by superposing alternate layers of field at right angles to each other, fails to produce stability. It is shown that the instability develops very short wavelengths in the direction perpendicular to the galactic gravitational field g and magnetic field B. The result is that the interstellar gas must be in a continual state of turbulence and fragmentation down to scales of 1 pc or less, terminating only when the clouds become so dense that self-gravitation becomes dominant. The turbulence and fragmentation enhance ambipolar diffusion to such an extent that the field escapes from the gas rapidly compared to the usual ambipolar rates. It is suggested that this may contribute to the escape of the magnetic fields from the interstellar gas which forms stars. (auth)

46053 STABILITY OF AN EQUILIBRIUM STATE FOR THE INTERSTELLAR GAS AND MAGNETIC FIELD. Lerche, I. (Univ. of Chicago). Astrophys. J., 149: 553-8 (Sept. 1967).

The stability of a simple equilibrium periodic system for the interstellar gas–magnetic field described in an earlier paper is discussed. It is demonstrated that the system is unstable with a growth time of the order of the free-fall time. The instability is of such a nature that the material tends to break up into clumps. In view of the fact that the periodic system is formed from a uniform atmosphere in a time of the same order, this calculation demonstrates that, at best, the periodic system can represent a transition phase of the interstellar gas–magnetic field system. It also shows that the formation of clumps of gas from a uniform atmosphere progresses in a time less than, or comparable to, the free-fall time. (auth)

46054 INITIAL-VALUE PROBLEM FOR OSCILLATIONS OF THE INTERSTELLAR GAS. Lerche, I.; Parker, E. N. (Univ. of Chicago). Astrophys. J., 149: 559-69 (Sept. 1967).

For a simple model of the interstellar gas–magnetic field system, in which the disk population of stars provides most of the gravity, it is demonstrated that a dispersion relation approach to the problem of small perturbations of the equilibrium state leads to unstable modes which possess a constant energy density at an infinite distance from the disk. Since one normally treats perturbations in which the energy density vanishes at infinity, rather than merely being bounded, an initial-value problem is investigated in which the energy density does vanish at infinity. It is shown, with one simple case, that an unstable situation still develops but that the perturbed quantities grow linearly with time rather than exponentially, as a normal mode analysis would indicate. It is further shown that one can still characterize the time scale for instability by the free-fall time so that conclusions drawn elsewhere by Parker remain valid. (auth)

46055 STABILITY OF IONIZATION FRONTS. Newman, R. C.; Axford, W. I. (Cornell Univ., Ithaca, N. Y.). Astrophys. J., 149: 571-6 (Sept. 1967).

The stability of plane strong D-type and weak R-type ionization fronts is considered, allowing for the absorption of ionizing photons in the H II region, and assuming that the H I and H II regions behave isothermally. No instabilities have been found for strong D-type ionization fronts, but weak R-type ionization fronts are moderately unstable if recombination is taken into account. (auth)

46056 QUANTITATIVE TESTS FOR S PROCESS IN STELLAR NUCLEOSYNTHESIS FOR SOLAR SYSTEM MATERIAL. Macklin, R. L.; Gibbons, J. H. (Oak Ridge National Lab., Tenn.). Astrophys. J., 149: 577-89 (Sept. 1967). (ORNL-P-2906).

Neutron-capture cross sections for selected isotopes of heavy elements were measured in the keV range by pulsed beam time-of-flight techniques. Maxwellian (kT ~ 30 keV) averaged cross sections obtained from these results show a very close inverse correlation with isotopic abundance for those isotopes whose sole origin has been assigned to the s-process (slow synthesis in red-giant stars). No similar correlation was found for isotopes which arise from p- or r-processes in agreement with earlier findings. Furthermore, no significant correlation was found between isotopic abundance and other nuclear properties such as binding energy of the last neutron or alpha particle. The results collectively give strong confirmation to the s-process theory of heavy-element formation in the solar system. (auth)

46057 NONRADIAL PULSATION OF GENERAL-RELATIVISTIC STELLAR MODELS. I. ANALYTIC ANALYSIS FOR $l \geq 2$. Thorne, Kip S. (California Inst. of Tech., Pasadena); Campolattaro, Alfonso. Astrophys. J., 149: 591-611 (Sept. 1967).

The theory of small, adiabatic, non-radial perturbations of a star away from hydrostatic equilibrium is developed within the framework of general relativity. The unperturbed equilibrium configuration is an arbitrary, non-rotating, general-relativistic stellar model. The departures from equilibrium are analyzed into tensorial spherical harmonics and then into complex normal modes with various mixtures of incoming and outgoing gravitational waves. A discussion is given of the expansion of real, physical pulsations with purely outgoing gravitational radiation in terms of the complex normal modes. Criteria are developed for stability against non-radial pulsations; and methods are devised for computing numerically the pulsation frequencies, eigenfunctions, and gravitational-radiation damping times of the stable, real quasi-normal modes of pulsation. (auth)

46058 PRE-WHITE-DWARF EVOLUTION. II. Vila, Samuel C. (Indiana Univ., Bloomington). Astrophys. J., 149: 613-18 (Sept. 1967).

Evolutionary models for the pre-white-dwarf stages of stars of 0.2, 0.4, 0.6 and 0.8 $M_\odot$ are obtained with and without the assumption of energy loss by neutrino production. Inclusion of neutrino losses decreases the central temperature and increases the rate of evolution for stars of 0.6 and 0.8 $M_\odot$ near the maximum central temperature. The importance of this effect decreases with the star's mass and can be ignored for stars of less than 0.4 $M_\odot$. For all masses considered, the energy loss by neutrino production can be neglected when the star's luminosity becomes less than

10^{-2} $L_\odot$; further evolution is then controlled by thermal cooling only. (auth)

46059 FINITE AMPLITUDE DENSITY VARIATIONS IN A SELF-GRAVITATING ISOTHERMAL GAS LAYER. Schmid-Burgk, J. (Univ., Heidelberg). Astrophys. J., 149: 727-9 (Sept. 1967).

The stability of a self-gravitating layer of isothermal, nonrotating gas infinitely extended in two dimensions has been studied by Ledoux (1951). He found such a layer to be marginally stable against sinusoidal density perturbations of vanishing amplitude that have a characteristic wavelength, $\lambda_L = C_s(2\pi/G\rho_0)^{1/2}$, where G is the gravitational constant, ρ_0 is the unperturbed density in the plane of symmetry, and C_s is the isothermal speed of sound of the gas. It is shown that, at the same wavelength, the spatially periodic variations in the layer are not restricted to infinitesimal amplitudes, and exact solutions to the relevant time-periodic equations can be given describing density distributions that are periodic in space and have arbitrary finite amplitude. (W.D.M.)

46060 METAL DEFICIENCY OF THE SECOND COMPONENT OF THE ECLIPSING SYSTEM U CEPHEI. McNamara, D. H. (Brigham Young Univ., Salt Lake City, Utah). Astrophys. J., 149: 723-5 (Sept. 1967).

Observations of the secondary component of U Cephei were secured in the c_1, b−y, m_1 photometric system at the primary minimum of October 7, 1966. The observational data were secured with the 24-inch telescope at Brigham Young University and are presented in tabular form. (W.D.M.)

46061 MEASUREMENTS OF ELECTRON TEMPERATURE FOR EIGHT PLANETARY NEBULAE. Schmitter, E. F.; Millis, R. L. (Univ. of Wisconsin, Madison). Astrophys. J., 149: 721-2 (Sept. 1967).

The electron temperatures of eight planetary nebulae were found by observing the ratio of the O III lines 5007 and 4363 Å. The measurements were made photoelectrically using the scanner of the 36-inch Cassegrain telescope at Pine Bluff Observatory as a monochromator fixed at the desired wavelengths. (W.D.M.)

46062 A NOTE ON EMISSION B STARS IN NGC 6530. Schmidt-Kaler, Th. (David Dunlap Observatory, Richmond Hill, Ont.). Astrophys. J., 149: 719-20 (Sept. 1967).

Two spectra of Walker No. 100 were obtained at the 74-inch telescope with a dispersion of 40Å/mm and a slit about 5-in. long and 1½ in. wide, covering the region between 3700 and 5000Å. Also, a number of plates were taken of Walker No. 65 with the same dispersion and a slit of about 5 × 1 in. Hβ appears on these spectra twice, in the second and third order. It is concluded that all these members of NGC 6530 are nonemission B stars. This is confirmed by photoelectric measurements of the Hβ index of Walker Nos. 65, 73, and 100. (W.D.M.)

46063 DETERMINATION OF ELECTRON TEMPERATURES FROM OBSERVATIONS OF RADIO LINES. Palmer, Patrick (Harvard Coll. Observatory, Cambridge, Mass.). Astrophys. J., 149: 715-18 (Sept. 1967).

Electron temperatures in H II regions obtained from the analysis of rf emission lines have been lower than the values obtained by optical methods, 5000 to 6000°K, as compared to 7,500 to 10,000°K. It is suggested that the differential departure from thermodynamic equilibrium and the electron temperature in the nebula may be determined by observing a pair of lines: the nα and the (n-1)β. The general equations relating the electron temperature to the observed line and continuum antenna temperatures are given and the method of determining the electron temperature and the differential departure from thermodynamic equilibrium is indicated. The explicit formulae for the case of small optical depth in the continuum emission are given. (W.D.M.)

46064 RELATIVE FLUX DENSITIES OF RADIO SOURCES AT A FREQUENCY OF 8 GHz. Haroules, G. G.; Brown III, W. E. Astrophys. J., 149: 711-13 (Sept. 1967).

The results of an observing program to determine a more accurate measurement flux-density ratios of radio sources at 8 GHz and to establish the internal precision of a homogeneous set of observations are reported. The 8-GHz flux densities of the radio sources Cas A, Cyg A, and M17 were measured relative to Taurus A in a nearly continuous 24-hour observing program during February through May, 1966. (W.D.M.)

46065 POLARIZATION MEASUREMENTS OF CYGNUS A AT 3.55-, 3.68-, 3.79-, 3.82-, AND 3.98-CM WAVELENGTHS. Hobbs, R. W.; Haddock, F. T. (Univ. of Michigan, Ann Arbor). Astrophys. J., 149: 707-10 (Sept. 1967).

Measurements of the linearly polarized component of the radiation from Cygnus A were made at five closely spaced wavelengths near 3.75 cm (8 GHz) using the 85-foot reflector of the University of Michigan. The measured values of the degree of polarization and position angle in general are not different from the values predicted using a two-component model for Cygnus A. (auth)

46066 INFRARED CORONAL LINES. II. OBSERVATION OF [Si X] λ1.43 μ AND [Mg VIII] λ3.03 μ. Munch, G.; Neugebauer, G.; McCammon, D. (Carnegie Inst. of Washington, D. C. California Inst. of Tech., Pasadena). Astrophys. J., 149: 681-6 (Sept. 1967).

The wavelengths and intensities of the coronal lines of the ions Si^{9+} and Mg^{7+}, resulting from the airborne observation of the November 12, 1966, total solar eclipse, are given. (auth)

46067 CORONAL FINE STRUCTURE IN X-RAY EMISSION. Broadfoot, A. L. (Kitt Peak National Observatory, Tucson, Ariz.). Astrophys. J., 149: 675-80 (Sept. 1967).

X-ray emission from five regions of coronal condensation formed images in a pinhole camera. Three of these regions were on the limb of the Sun and were found to be $2.2 \pm 0.3 \times 10^4$ km above the photosphere. Intensity profiles, across the most intense x-ray regions, were obtained with an angular resolution of about 0.5′ and with coarse spectral separation. (auth)

46068 EXACT SOLUTION IN THE THEORY OF LINE FORMATION IN STELLAR ATMOSPHERES. Siewert, C. E. (North Carolina State Univ., Raleigh); McCormick, N. J. Astrophys. J., 149: 649-53 (Sept. 1967).

A rigorous solution for the monochromatic radiation intensity at any optical distance into a semi-infinite stellar medium is presented. The model of the atmosphere allows for general continuous absorption as well as for monochromatic line scattering that is linearly anisotropic in the cosine of the scattering angle; however, it is assumed that the Planck distribution can be represented by a linear function of the optical thickness. (auth)

46069 INFLUENCE OF WATER-VAPOR OPACITY AND THE EFFICIENCY OF CONVECTION ON MODELS OF LATE-TYPE STARS. Auman, Jason R.; Bodenheimer, Peter (Princeton Univ., N. J.). Astrophys. J., 149: 641-8 (Sept. 1967).

The minimum theoretical effective temperatures for red-giant and pre-main-sequence stars are calculated for a number of masses, both with and without the opacity due to water vapor, for two sets of parameters which determine the efficiency of convective energy transport. It is found that the resulting limiting temperatures are more sensitive to the assumptions concerning convection than to the inclusion of water vapor. When the convective parameters are taken to be those appropriate to main-sequence stellar models, the minimum effective temperatures are calculated to be about 3200°K. If the parameters are adjusted, within reasonable limits, so that the convective efficiency is reduced, and if water-vapor opacity is included, effective temperatures as low as 2600°K are obtained. The results are discussed in terms of the observed effective temperatures of the coolest red giants and the "infrared" stars. (auth)

46070 HD 118216: A SEMIDETACHED CLOSE BINARY VIEWED AT LOW INCLINATION. Conti, Peter S. (Univ. of California, Santa Cruz). Astrophys. J., 149: 629-40 (Sept. 1967).

Spectroscopic observations of the short-period binary HD 118216 reveal the presence of Ca II emission from the secondary star. The mass ratio is 0.28. In addition, the system occupies a unique place in a B−V, V−I diagram of bright main-sequence stars. The size of the secondary is predicted from the spectroscopic and photometric observations, which is close to that of the Roche lobe. This is a semidetached, close binary system which is viewed at low inclination. Such systems have previously been identified only at high inclination through observations of eclipses. (auth)

46071 APSIDAL CONSTANTS OF STELLAR MODELS. Mathis, J. S. (Univ. of Wisconsin, Madison). Astrophys. J., 149: 619-27 (Sept. 1967).

The apsidal motion constants for main-sequence models of two compositions, X = 0.596, Z = 0.02 and X = 0.730, Z = 0.02, are presented for masses ranging between 1.5 and 10.0 solar masses. Apsidal constants for evolved models for X = 0.596 are given for 5.0 and 2.0 $M_\odot$. The opacities used in the models are due to Cox, Stewart, and Eilers. The work of Peraiah, in which it is assumed that apsidal motion binaries are rotating much more rapidly than synchronously, is discussed. It is concluded that observational evidence on rotation militates against this theory. The sensitivity of the observationally derived apsidal constant to errors in the rotational velocities, stellar radii, and eccentricity is discussed. It is concluded that the errors in the stellar radii contribute most to the uncertainty in the apsidal constant. The apsidal constants of the theoretical models agree quite well with the observed ones, noticeably better than the older theoretical apsidal constants based on Keller−Meyerott opacities. (auth)

46072 MEASUREMENT OF COSMIC BACKGROUND RADIATION AT 3.2-CM WAVELENGTH. Roll, P. G.; Wilkinson, David

T. (Princeton Univ., N. J.). Ann. Phys. (N.Y.), 44: 289-321 (Sept. 1967).

A measurement of the equivalent temperature of the cosmic microwave background radiation at 3.2 cm wavelength is described. The result, $T_{BG} = (3.0 \pm 0.5)^{\circ}K$, has already been reported and discussed [Phys. Rev. Letters, 16: 405 (1966)]. This paper describes the apparatus and technique used for the measurement with particular emphasis on the sources of error. After a summary of the general requirements on a radiometer used for background measurements, the Dicke-type radiometer which was designed and built especially for this measurement is discussed. The design and testing of the critical components—the antenna, the reference termination, and the switch—are dealt with in some detail. It was necessary to measure and substract off the radiation due to oxygen and water vapor in the atmosphere and this technique is discussed. Also, some techniques used in making precision measurements of waveguide and antenna loss are described. The result is discussed briefly. (auth)

46073 ADVANCES IN ASTRONOMY AND ASTROPHYSICS, VOLUME 5. Kopal, Zdenek (ed.). Advan. Astron. Astrophys., 5: 1-355(1967).

Separate abstracts were prepared on the five sections. (W.D.M.)

For abstracts of individual sections see: 46074–46078.

46074 ZODIACAL LIGHT. Blackwell, D. E. (Oxford Univ.); Dewhirst, D. W.; Ingram, M. F. Advan. Astron. Astrophys., 5: 1-69(1967).

Present knowledge of the zodiacal light and the interplanetary dust is discussed. (W.D.M.)

46075 THREE-DIMENSIONAL PERIODIC OSCILLATIONS ABOUT L_1, L_2, AND L_3. Bray, T. A.; Goudas, C. L. (Boeing Co., Seattle). Advan. Astron. Astrophys., 5: 71-130(1967).

Three families of three-dimensional motions presented are considered from both the analytic and numerical points of view so that comparison of their results is possible. The members of each family pass very close to one of the three equilibrium points L_1, L_2, and L_3 but only a few of them can be described as oscillations around these points, especially in the case of L_2 and L_3. The majority of the solutions encircle both primaries. (W.D.M.)

46076 SECULAR VARIATION OF MASS AND THE EVOLUTION OF BINARY SYSTEMS. Hadjidemetriou, John (Univ. of Manchester, Eng.). Advan. Astron. Astrophys., 5: 131-88(1967).

The secular variation of mass and the evolution of binary stellar systems are discussed in terms of general equations of motion of a body with variable mass, analytic solutions for the case of isotropically decreasing mass, interaction between the ejected mass and the two stars, high rates of mass ejection, motion around an attracting center of variable mass (surrounded by a resisting medium), and secular increase in mass. (W.D.M.)

46077 PERIODICITY OF THE SUNSPOT GROUPS. Kopecky, Miloslav (Astronomical Inst., Ondrejov, Czechoslovakia). Advan. Astron. Astrophys., 5: 189-266(1967).

An attempt is made to sum up all particulars on the laws that apply to the periodicity of both number of spot groups formed and the spot-group importance as known from the latest results of research done by a wide range of authors. (W.D.M.)

46078 COMPACT AND DISPERSED COSMIC MATTER, PART I. Zwicky, F. (Mount Wilson and Palomar Observatories, Pasadena, Calif. Carnegie Institution of Washington, Washington, D. C. California Inst. of Tech., Pasadena). Advan. Astron. Astrophys., 5: 267-343(1967).

Compact and dispersed cosmic matter is considered in terms of periods of progress in the 20th century; the morphological approach to discovery, invention, and research in astronomy; specific vistas achieved through the morphological approach; and observational discoveries made as a result of the morphological approach. (W.D.M.)

46079 ON THE CORRECTION FOR FORESHORTENING FOR Ca PLAGES. Godoli, G.; Monsignori Fossi, B. C. (Osservatorio Astrofisico Arceti, Florence). Solar Phys., 1: 148-50(Jan. 1967).

On the basis of the spectroheliographic material collected at Arcetri during the IQSY, the evolution of 26 Ca plages which were formed in 1964 has been recently studied. Each plage was observed continuously during each transit. For each plage the daily projected areas A_p have been determined and plotted versus time. The projected areas A_p have been transformed into corrected areas A_c according to the well-known formula $A_c = A_p \sec h$ (h = heliocentric angle of the plage). From the plots of the daily corrected areas A_c versus time, it became evident that the correction for foreshortening according to the formula is not satisfactory: areas A_c show a systematic increase from the center to the limb. For this reason an attempt was made to determine directly a new correction factor from the plots of the areas A_p versus time. (W.D.M.)

46080 PHOTOELECTRIC PHOTOMETRY OF SOLAR GRANULATION IN SEVERAL REGIONS OF THE CONTINUUM. Vassileva, G. Ya. (Pulkovo Observatory, Academy of Sciences, USSR). Solar Phys., 1: 16-26(Jan. 1967).

Photospheric brightness fluctuations were recorded photoelectrically across a part of the Sun near the center of the disk, and simultaneously for two regions of the continuous spectrum chosen at various wavelengths between λ3500 and λ5500 Å. The autocorrelation functions and spatial power spectra were derived for each recording, and the cross-correlation functions, spatial relative phase and coherence spectra were computed for each pair of recordings. The main results are: (1) The cross-correlation between any two recordings obtained for various regions of the continuous spectrum, is a function of the wavelength distance Δλ between these regions. The decrease of the cross-correlation with increasing Δλ is due to the fact that separate photometric inhomogeneities radiate in limited spectral ranges. (2) A constant relative displacement of the location of the brightness fluctuations in two different regions of the continuum, expressed in an asymmetry of cross-correlation function, is observed. On the average, the "violet" inhomogeneities are displaced to the west relatively to "yellow" ones in all fifteen cases investigated. (3) The correlation radius depends on the wavelength and increases by a factor 3 to 4 from λ5400 to λ3500 Å. (4) Sometimes a periodic systematic component in the autocorrelation and cross-correlation functions is observed. This component seems to be caused by supergranulation. For 16 long recordings the wavelength Λ_0 of this component has a mean value of $(22 \pm 6) \cdot 10^3$ km and does not show any clear dependence on λ. (auth)

46081 A SYSTEMATIC METHOD FOR THE ANALYSIS OF HIGH-RESOLUTION FRAUNHOFER LINE PROFILES. De Jager, C. (Univ., Utrecht); Neven, L. Solar Phys., 1: 27-59(Jan. 1967).

A Fraunhofer line profile depends on various parameters, partly related to the photospheric structure (T, P_g, P_e, v_{conv}, v_{turb}), partly to the atom or ion involved (such an oscillator strength, energy levels), partly also resulting from the interaction of the relevant kind of particles with the photosphere, and the photospheric radiation field. In this paper particular attention is paid to the determination of: the macroturbulent (convective) velocities, $v_{conv}(\tau)$; the damping constant $\gamma(\tau)$; the abundance, A_{el}; the distribution function $\varphi(v_{conv},\tau)$ of the convective velocities at each depth τ; the source function, $S(\tau)$; and the microturbulent velocities, $v_{turb}(\tau)$. (auth)

46082 OBSERVATIONS OF A FLARE SPRAY AT THE SOLAR LIMB ON JULY 11, 1966. Ohman, Y.; Stiber, G.; Kusoffsky, U. (Swedish Astrophysical Station, Capri, Italy). Solar Phys., 1: 60-5(Jan. 1967).

A brief description is given of a spectacular flare spray that appeared outside the west solar limb on July 11, 1966. Observations were made at the Swedish Solar Observatory in Anacapri with (a) a 0.7 Å Hα filter combined with the flare patrol instrument, and with a 5 Å Hα filter attached to the 8-cm coronagraph, (b) in white light and with a polarization measuring device attached to the 12-cm coronagraph, (c) in the helium D_3 and Hα spectrum regions with the 20-cm solar telescope and a Babcock grating in fourth order. During the brilliant phase the intensity of the object measured with the 0.7 Å Hα filter was 1.6 times that of the undisturbed solar surface near the center of the disk. The object could be faintly traced even in white light outside the solar image when projected on a screen. The brilliant area had an apparent size of about 30 square degrees of the solar surface. When classified as a flare it should probably be given the importance 4n therefore. Already a preliminary examination of the exposures secured for the purpose of measuring polarization, gives clear evidence of strong effects of radial polarization (vibration tangential to the limb) suggesting Thomson scattering as the main source of the continuous spectrum. The spectra obtained show great Doppler shifts and mainly towards shorter wavelengths, corresponding to velocities of as much as 500 km/sec. In the latter development a rapid outflow of matter could be observed and particularly with the 5 Å Hα filter. (auth)

46083 DETAILED ANALYSIS OF FLARES, MAGNETIC FIELDS, AND ACTIVITY IN THE SUNSPOT GROUP OF SEPT. 13–26, 1963. Zirin, Harold; Werner, Susan (Carnegie Inst. of Washington, D. C. California Inst. of Tech., Pasadena). Solar Phys., 1: 66-100(Jan. 1967).

Large-scale H-alpha movies of the large spot group of Sept. 13–26, 1963, together with radio, ionospheric, and magnetic field data as well as white light pictures were analyzed. The evolution of the group and associated magnetic fields is followed, and the positions of solar flares relative to the fields are noted, along with their morphology. Although the magnetic field is deformed in time, characteristic field structures may be traced through the deformation as the seat of recurrent homologous flares. It was found that most flares are homologous, and some are triggered by disturbances elsewhere in the region. Events produced by surges falling back to the surface are noted, and one flare initiated by a bright bead seen to fly across the region. In almost every case of an isolated type-III radio burst, a corresponding H-alpha brightening could be found, but not all flares produced bursts. Flares close to the sunspots are most likely to produce radio bursts. Flare surface waves in the region all travel out to the west, because of more open magnetic field structure there. In one case (Sept. 25) a wave is turned back by the closed field structure to the east. In almost all cases the time association of radio or ionospheric events is with the beginning of the flare or with the flash phase. Several morphological classes of flares are noted as recurrent types. (auth)

46084 DIFFERENCE OF THE CHROMOSPHERIC BACKGROUND INTENSITY BETWEEN THE EQUATORIAL AND POLAR REGIONS OF THE SUN. Macris, C. J. (Astronomical Inst., Athens). Solar Phys., 1: 101-6(Jan. 1967).

Small chromospheric emission centers (here defined as flocculi) were studied photometrically on $K_{2,3,2}$ spectroheliograms taken at the Arcetri Observatory. The intensity ratio between I_{fl}, the flocculus brightness, and I_{chr}, the brightness of the chromospheric background, was determined. A difference was found between the polar and the equatorial limb values of the ratio I_{fl}/I_{chr}. (auth)

46085 ON THE 11-YEARS CYCLE OF SOLAR ACTIVITY. Gnevyshev, M. N. (Pulkovo Observatory, Academy of Sciences, USSR). Solar Phys., 1: 107-20(Jan. 1967).

Each 11-year cycle of solar activity consists of two processes with different physical properties. The variety of shapes of the 11-year curves depends on the way these processes overlap. All events in the photosphere, chromosphere, and corona, and all kinds of emissions like the radio and corpuscular emissions take part in these two processes. Events taking place in the magnetosphere, ionosphere, and troposphere, and perhaps some chemical and biological events reflect the essential properties of the 11-year cycle. (auth)

46086 OBSERVATION OF THE S COMPONENT OF THE SOLAR RADIO EMISSION BY AN EIGHT ELEMENT GRATING INTERFEROMETER AT 17 Gc/s. Tsuchiya, Atsushi; Nagane, Kiyoshi (Tokyo Univ.). Solar Phys., 1: 121-4(Jan. 1967).

The slowly varying components (S components) of the solar radio emission were observed by a 17-Gc grating interferometer. In combination with 4-Gc data, it is deduced that the source of the 17 Gc S component is optically thin. (auth)

46087 GLANCING-INCIDENCE SOLAR TELESCOPE FOR THE SOFT X-RAY REGION. Underwood, J. H. (National Academy of Sciences/National Research Council, Washington, D. C.); Muney, W. S. Solar Phys., 1: 129-44(Jan. 1967).

The instrumentation of an Aerobee rocket (NASA 4.95 GS) which was launched from White Sands Missile Range on May 20, 1966, to observe the Sun in the soft x-ray region is described. The experiment package, which was pointed at the Sun by a control system stabilized about all three axes, carried two Wolter type-I glancing-incidence telescopes to photograph the Sun in wavelength regions (determined by bandpass filters) between 3 and 75 Å, and two proportional counters to obtain flux data and rough spectral shapes in the regions 2 to 11 Å and 8 to 20 Å. The spatial resolution obtained was about 20 arc seconds. Limb brightening and polar darkening are very pronounced at the longer wavelengths. A tuft of emission was observed at the North Pole in addition to an arch-like structure on the NW limb. Several of the photographs are presented, and some preliminary results are discussed. (auth)

46088 RECONNECTION OF MAGNETIC FIELD OF ACTIVE REGIONS BY THE INTERACTION OF THEIR EXTENSIONS IN INTERPLANETARY SPACE. Gopasyuk, S.; Krivsky, L. (Astronomical Inst., Czechoslovak Academy of Sciences, Ondrejov). Solar Phys., 1: 145-7(Jan. 1967).

When identifying glares connected with Forbush effects in cosmic radiation, on the basis of the hypothesis of the interplanetary magnetic bottle, it has been found that Forbush decreases are occasionally even possible when the flare source is located near the eastern limb. In the suggested model of this phenomenon, there occurs in space an interaction of drawn-out magnetic fields of solar origin from widely separated active regions, which interact and are connected according to Sweet's (1958) mechanism. On the basis of Syrovatskii's (1966) criterion this process of conjunction will be highly effective and will lead to the formation of a very large magnetic bottle. (W.D.M.)

46089 AMPLITUDE DISTRIBUTIONS OF SOLAR PHOTOSPHERIC FLUCTUATIONS. Edmonds, Frank N. Jr. (Univ. of Texas, Austin). Solar Phys., 1: 5-15(Jan. 1967).

Amplitude distributions, which are nearly Gaussian, were calculated for radial velocity, continuum brightness, spectral line equivalent width, and spectral line central residual intensity fluctuations measured from high-dispersion high-resolution spectrograms taken at the center of the solar disk. The RMS and skewness S for each distribution were calculated in a manner which allows testing of the homogeneity of the granulation pattern (i.e., variations in its statistics across the solar disk and with time). Pattern inhomogeneity across the disk is strongly indicated, and further evidence suggesting appreciable pattern persistence over time intervals $\gtrsim$15 minutes is presented. The possibilities for investigations of S and its associated bi-spectrum are discussed. The qualitative values of S obtained are shown not to be due to unusually bright, rising granules (though a statistical tendency towards such granules is possible). An attempt to explain S for continuum brightness fluctuations in terms of the nonlinear effects of Planckian emission and opacity fluctuations in a stratified photosphere, leads to contradiction with the measured amplitude distributions, a contradiction which is probably due to an oversimplified treatment of radiative transfer in an inhomogeneous photosphere. (auth)

46090 THE SAGAMORE HILL SOLAR RADIO OBSERVATORY AND THE EVENT OF AUGUST 28, 1966. Castelli, J. P. (Air Force Cambridge Research Labs., Bedford, Mass.); Michael, G. A. Solar Phys., 1: 125-8(Jan. 1967).

A brief description is presented on the brilliant solar flare which occurred on August 28, 1966. A proton event began about an hour after the flare. PCA X/1DB was reported. The geomagnetic storm starting at 13:14 U.T. on August 29 was probably caused by the flare. (W.D.M.)

46091 REMARKS ON POSSIBLE CONNECTION BETWEEN COSMOLOGY AND ATOMIC PHYSICS. Ivanenko, D. (Moscow Univ.). Wiss. Z. Friedrich-Schiller-Univ. Jena, Math.-Naturwiss. Reihe, 15: 167(1966).

An evaluation of the mass of a graviton from Einstein equations with cosmological terms is compared with $^2H = \lambda = (m_{gr}c^2/\hbar)^2$. Attempts can be made to evaluate the mass of a graviton extending the well-known empirical relation between masses of protons and electrons and constants of strong and electromagnetic coupling to ultraweak gravitational interactions. Two fundamental features of the real universe are considered: its expansion and overwhelming preponderance of particles over antiparticles, which may not be independent of one another. It is conjectured that due to expansion of the universe there is no strong T parity conservation and no CP conservation. These concepts are applied to recently discovered T nonconservation at $K_2^0 \to 2\pi$ decay. Possibly real inversion may consist not only in supplementing space inversion by transition to antiparticles, but also by transition from an expanding to a contracting universe. The effect of expansion (or contraction) is considered as a rough approximation as an influence of a cosmological force acting differently on particles and antiparticles, i.e. K^0 and $\bar{K}^0$. Due to the influence of such a highly hypothetical ultra-ultra-weak cosmological force, K_2^0 mesons may appear as a mixture of previously pure local $(K_2^0)_0$ and $(K_1^0)_0$. Other concepts which may establish links between cosmological and quantum elementary processes are considered. (BBB)

46092 SOLAR FLARES AND CHEMICAL PHENOMENA. Piccardi, Giorgio (Univ., Florence). Geofis. Meteorol. (Genoa), 16: 11-12(Jan.-Apr. 1967).

The correlation of 2 chemical tests (so-called F and P tests) for solar–geomagnetic activity with proton flare data is discussed. The correlation is based on results of automated and standardized chemical tests performed for over 15 yr, with more than 40,000 numerical data recorded in Florence as well as other data recorded all over the world, in both hemispheres. These ~40,000 data form a homogeneous unit, by which statistical analysis can be made. The numerical values from these tests fluctuate in the course of time, and these fluctuations enabled a relation between the tests and solar activity to be detected. Test F results show a sharp peak in connection with the day of the solar eruption. By synchronizing the proton flare data with test P data (which seemed to respond more intensely than the other test to these flares), a marked effect during periods of great solar activity was noted. One instance of correlation of test P data with a recent solar flare is examined in detail. (BBB)

46093 COSMIC POSITION OF QUASISTELLAR RADIO SOURCES. Schmeidler, Felix (Univ., Munich). Naturwiss. Rundsch., 20: 93-5(Mar. 1967). (In German).

The most recent proposals on the nature of quasars are reviewed and criticized. Particular attention is devoted to the local hypothesis of McCrea and of Hoyle and Burbidge, and to McCrea's comparison of the special relativity, de Sitter, and Friedmann models of the Universe with respect to the location of radio sources, in which the special relativity model was shown to give the most reasonable result. Hoyle and Burbidge's argument based on the magnitude of the inverse Compton effect is also reviewed, as well as their explanation of the redshift. Comments on the periodicity of the sources are made. Future experimentation and observation are necessary to confirm the local hypothesis. (BBB)

46094 ABUNDANCE DETERMINATIONS FROM STELLAR SPECTRA. Cayrel, R.; Cayrel de Strobel, G. (Observatoire de Paris, Meudon, France). Annu. Rev. Astron. Astrophys., 4: 1-18(1966).

This review (116 references) reveals that about 300 stars showing at least 10 different types of abundance peculiarities have been studied, chiefly during the last 5 yr. The principal value of abundance determinations from stellar spectra is the clues they give to the nuclear history of stellar matter and, more generally, of the matter in the whole Galaxy. The following topics are reviewed: critical analysis of the methods used to obtain the abundances, metals-to-hydrogen ratio, lithium abundance, helium stars, and barium stars. The interpretation of the abundances found in stellar atmospheres is discussed. A real abundance peculiarity is not necessarily the consequence of a nuclear process; other processes may be able to alter the chemical composition of a stellar atmosphere. Model-atmosphere analysis is examined, as well as the nonlocal thermodynamic equilibrium controversy. The metals-to-hydrogen ratio in various stars are tabulated. The lithium abundance, which shows a considerable spread in otherwise normal F and G stars, is discussed. It is concluded that the bearing of abundance determinations on a full understanding of stellar evolution and the nuclear history of the Galaxy is becoming more and more obvious. Some questions needing further investigations are considered. (BBB)

46095 INFLUENCE OF THE MAGNETIC FIELD ON THE FLUX OF RADIO EMISSION FROM SOURCES ASSOCIATED WITH SUNSPOT GROUPS. Abbasov, A. R. (Leningrad State Univ.). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 129-30(1967).

Translated from Geomagn. Aeronomiya, 7: 170-1(1967).

Previous investigations indicate that the synchrotron mechanism plays an important role in the emission of sources above sunspot groups in the centimeter range. In such a case the magnetic field intensity in a group must have a substantial effect on the radio noise flux from the source. The results of a study relating to 3.2- and 7.5-cm waves are reported to elucidate the characteristics and degree of this relationship. (J.H.M.)

46096 NATURE AND GEOPHYSICAL EFFECTIVENESS OF AGENTS RESPONSIBLE FOR TYPE II AND IV SOLAR RADIO BURSTS. Fomichev, V. V.; Chertok, I. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radiowave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 1-3(1967).

Translated from Geomagn. Aeronomiya, 7: 3-6(1967).

By statistical analysis of the agents responsible for type-II and -IV radio bursts, it is shown that the rather high velocity of a plasma blob ejected from the region of a chromospheric flare and the intensity of its internal magnetic field are mutually independent phenomena. An attempt is made on this basis to analyze the relationship between type-II and -IV radio bursts and to determine the properties of the agents producing each of these two types of bursts. (auth)

46097 ISOTROPIC GAMMA-RAY INTENSITY IN AN EXPANDING UNIVERSE. Cheng, Chung-chieh (Harvard Coll. Observatory, Cambridge, Mass.). Nature (London), 215: 1035-8(Sept. 2, 1967).

The intensities of isotropic gamma rays produced by the inverse Compton process in an expanding universe are calculated, including the effect of red shift on the radiation field. The results may give information concerning the universal black-body radiation field and the intergalactic electron flux intensity. (auth) (UK)

46098 OBSERVATIONS OF SMALL-SCALE SOLAR MAGNETIC FIELDS. Sheeley, N. R. Jr. (Kitt Peak National Observatory, Tucson, Ariz.). Solar Phys., 1: 171-9(Mar. 1967).

Spectrograms, obtained during moments of good seeing with the high spatial resolution afforded by the 80-cm solar image at the Kitt Peak National Observatory, show the following: (1) Magnetic fields of several hundred gauss occur in tiny areas easily as small as 500 km in extent in regions of the solar surface sometimes well removed from areas of sunspot activity. (2) In these tiny areas of magnetic field, many Fraunhofer lines seem to be weakened, appearing on spectrograms as discontinuities or gaps in the absorption lines. (3) Although the small-scale magnetic fields are manifested by local weakenings of many absorption lines, these fields often correspond to local darkenings in the continuum, suggesting that the small-scale fields often occur in the dark lanes and pores of the granulation. (4) These tiny areas of relatively strong magnetic field correspond to regions of bright Ca^+ K_{2S} emission, not to the so-called K_{2V} bright points seen on spectroheliograms. It is implied that these relatively strong fields associated with the weakenings or gaps in Fraunhofer lines are precisely the fields detected using Leighton's photographic technique. (auth)

46099 EVIDENCE OF SOLAR GRANULATION AT 2000 A. Blamont, J. E.; Carpentier, G. (CNRS, Verrieres-le-Buisson, France). Solar Phys., 1: 180-90(Mar. 1967). (In French).

Eight ultraviolet monochromatic pictures at the limb of the sun are analyzed for evidence of granulation in this spectral range (λ = 2000 Å). The spectral window (125 Å) is defined by two interference filters. These high-resolution pictures were obtained with a 20-cm Cassegrain telescope carried at 30,500 m of altitude by a stratospheric balloon. The resolution of the telescope is 1 sec. The instrument is mounted on a Sun-pointing control of excellent short time stability (2 sec). The pictures were taken at intervals of 210 seconds with a 0.25-second exposure. Large brilliant irregularities 10 to 20 sec in width are interpreted as chromospheric microfaculae with a half-hour lifetime. On the other hand, the smaller irregularities are interpreted as ultraviolet granulation. Using the correlation and structure functions, the analysis of the density distribution shows that spatial correlation of these irregularities is limited to a 4-sec range. (auth)

46100 MODEL OF THE INHOMOGENEOUS CHROMOSPHERE OF THE SUN. Krat, V. A. (Pulkovo Observatory, Academy of Sciences, USSR). Solar Phys., 1: 191-203(Mar. 1967).

A new model is proposed for the solar chromosphere, which is assumed to be an instable inhomogeneous formation, consisting of numerous elements (filaments), each with different temperature and density. Fluctuations of the magnetic field may give rise to chromospheric turbulence and may also cause the chromospheric inhomogeneities. (auth)

46101 MOTIONS OF CHROMOSPHERE FINE STRUCTURE IN A WEAK PLAGE. Zirker, J. B. (Univ. of Hawaii, Honolulu). Solar Phys., 1: 204-15(Mar. 1967).

Motions in an old center of activity were studied at the limb with the use of time-resolved Hα spectra. The observations were made at intervals of 5 seconds over a period of $^3/_4$ hour of good seeing at Sacramento Peak Observatory. Objects in this region have larger line-of-sight velocities than have been reported for spicules in quiet regions. Velocities as high as 70 km/sec were observed; 17% of a sample of 200 instantaneous velocities exceed 30 km/sec. The line-of-sight velocities of 20 objects were measured as a function of time. For 5 of these, transverse velocity components could also be estimated. A single pattern, such as the simple rise without fall reported by Mouradian, does not exist. The motion is often quite complex, involving lateral expansion, shear, and occasionally, splitting. Reversal of sign of the velocity is not uncommon. (auth)

46102 VARIABILITY OF THE INTEGRATED SOLAR K LINE EMISSION. Bumba, V.; Ruzickova-Topolova, B. (Astronomical Inst., Czechoslovak Academy of Sciences, Ondrejov). Solar Phys., 1: 216-19(Mar. 1967).

The preliminary results seem to demonstrate the facts that the Sun observed as a star in the light of the K and H lines is variable, and that this variability is closely related to that of the magnetic field intensity, or to the distribution of magnetic fields, and hence to the distribution of calcium plages or photospheric faculae in the solar atmosphere. This variability will not so much be related to the variation of Wolf's relative sunspot numbers or to the variation of the sunspot area. The applicability of the obtained results for the examination of the late-type stars seems to be evident. (auth)

46103 CURRENTS IN THE SOLAR ATMOSPHERE AND A THEORY OF SOLAR FLARES. Alfven, H.; Carlqvist, P. (Royal Inst. of Tech., Stockholm). Solar Phys., 1: 220-8(Mar. 1967).

Topics discussed include definition of the electromagnetic state, measurements of magnetic fields and currents, description of the electromagnetic state by the current system, circuit interruption, maximum current through a plasma, disruption of the current, instability of a current in a completely ionized gas, applications to solar conditions, qualitative picture of solar flare, and quantitative considerations. (W.D.M.)

46104 SOLAR ABUNDANCE DETERMINATION FROM ULTRAVIOLET EMISSION LINES. Dupree, Andrea K.; Goldberg, Leo (Harvard Coll., Cambridge, Mass.). Solar Phys., 1: 229-41(Mar. 1967).

The intensities of far ultraviolet emission lines from the solar corona are analyzed to determine relative coronal abundances for oxygen, silicon, and iron. Dielectronic recombination is included in the formulation of ionization equilibrium. Observations of solar radio emission are used to obtain abundances relative to hydrogen. The absolute coronal abundances appear to be in agreement with their respective photospheric values. General properties of the structure of the chromosphere and corona are deduced from the analysis of observed emission in the ultraviolet and radio wavelength regions. (auth)

46105 DISTRIBUTION OF THE 9-CM RADIO EMISSION OVER THE SOLAR DISK DURING THE SUNSPOT MINIMUM. Roosen, J.; Goh, T. (Utrecht Univ. Netherlands Foundation for Radio Astronomy, Utrecht). Solar Phys., 1: 242-53(Mar. 1967).

The brightness distribution of the quiet Sun at 9.1 cm was determined from the Stanford pencil-beam radioheliograms for three periods in the recent solar activity minimum, centered at July 15 and September 15, 1964 and at April 5, 1965. The brightness maxima near the limbs are not symmetric with respect to the central meridian, but are situated at 76°E and 66°W longitude, respectively. On the disk, the brightness temperature is likewise distributed asymmetrically, but the direction of this asymmetry changes as the new cycle starts. The asymmetries are tentatively explained by assuming the presence of inhomogeneous streamers in the solar atmosphere, which are tilted by the solar rotation. The eastward shift of the limb maxima with respect to the optical disk is confirmed by the 21-cm heliograms obtained at Fleurs near Sydney, Australia. (auth)

46106 INTERACTION OF THE SOLAR WIND WITH A COMET. Biermann, L.; Brosowski, B.; Schmidt, H. U. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Solar Phys., 1: 254-84(Mar. 1967).

The flow of plasma on the sunward side of a comet is investigated by means of an axial-symmetric model based on hydrodynamics modified by source terms. The model assumes a given curvature of the isobaric surfaces, which corresponds to paraboloids around the nucleus of the comet. The flow on the axis can be represented by a solution of a system of seven ordinary differential equations. The flow pattern always contains a widely detached bow shock and a contact discontinuity separating a cavity with purely cometary plasma from the transition region containing also solar wind ions. The model is applied to the special case where the cometary gas is ionized by the solar uv radiation only. Numerical solutions are integrated for five levels of production of neutral gas by the comet and for seven typical situations in the undisturbed solar wind. The results imply standoff distances of the stagnation point from the nucleus of the order of 10,000 km or more, and distances of the bow shock of the order of 10^6 to 10^7 km. (auth)

46107 C I AND CH LINES IN SOLAR SPECTRUM. Baschek, B.; Holweger, H. (Neue Univ., Kiel). Z. Astrophys., 67: 143-54(1967). (In German).

An investigation of 25 solar lines of $CH(A^2\Delta - X^2\Pi)$ near λ 4300 was carried out for two positions on the solar disk ($\cos\vartheta = 1$ and 0.3). The line profiles were computed by direct integration of intensities using the solar model by Holweger, 1967. From these lines $\log g_e f_e \epsilon_C = 6.66$ for $\cos\vartheta = 1$ and 6.58 for $\cos\vartheta = 0.3$ were calculated. There is no evidence of departures from LTE for the CH lines. With the carbon abundance $\log \epsilon_C = 8.51$ as derived from atomic C I lines, the solar f value of the $A^2\Delta - X^2\Pi$ transition of CH: $\log f_e = -2.45$ was determined. The excitation temperature of the CH lines was found to be approximately $T_{exc} = 5200°K$. (auth)

46108 DETERMINATION OF THE ABUNDANCE RATIO $^{12}C/^{13}C$ IN SOLAR ATMOSPHERE. Richter, Johannes; Tonner, Karl-Friedrich (Neue Univ., Kiel). Z. Astrophys., 67: 155-64(1967). (In German).

The wavelengths of lines belonging to the violet (0,0) bands of the molecules ^{12}CN, ^{13}CN, ^{12}CH, and ^{13}CH were measured. Several pairs of relatively undisturbed isotopic $^{12}CH - ^{13}CH$ rotational lines could be identified in the solar spectrum. From their equivalent widths a solar abundance ratio $^{12}C/^{13}C = 100 \pm 30$ can be derived. (auth)

46109 SIMPLE MODEL FOR GRAVITATIONAL COLLAPSE WITH PRESSURE GRADIENT. Nariai, Hidekazu (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto), 38: 92-106(July 1967).

A simple model for gravitational collapse with pressure gradient, but without energy flow, is investigated within the framework of general relativity. The model is regular at all times throughout the entire region in such a way that all interior events can send signals to external observers. The mass-radius relation of the model provides us with the inequality $GM/c^2R_b < 0.375$, which is comparable with the analogous ones due to Buchdahl and Bondi for static fluid spheres. The usual assumption of quasi-static equilibrium is, however, prohibited in the model, because its fluid velocity can attain about one-tenth the speed of light. The gravitational potential and binding energies are calculated, but the result for the latter, i.e., B. E. = 0, is not unique. The spectral shift of a light or neutrino ray to be received by an external observer is also analyzed, whose formula is an extension of the previous one in the case of gravitational collapse or anticollapse with uniform density and negligible pressure. (auth)

46110 THE CORONA AT THE TOTAL SOLAR ECLIPSE OF 1952 FEBRUARY 25. II. THE LINE SPECTRUM. Falchi, A.; Falciani, R.; Rigutti, M. (Osservatorio Astrofisico di Arcetri, Florence). Z. Astrophys., 67: 115-22(1967).

The coronal line spectra obtained at the eclipse of 1952 have been studied. These spectra show also the line at λ 6916 Å whose presence in the coronal spectrum was noted for the first time by Wlérick and Fehrenbach in 1963. The energies emitted in the lines are given. No use is made of the hypothesis of spherical symmetry of the corona. Instead, ions with ionization potentials of the same order of magnitude or ions which can surely coexist in a given coronal region were grouped. It was found that such a coronal region can be considered as isothermic. Relative abundances of Ni and Fe can be determined without making any "a priori" assumptions. A comparison is made with earlier determinations. (auth)

46111 OB STAR GROUPS IN THE SOUTHERN MILKY WAY. Klare, Gerhard (Mitteilungen der Landessternwarte, Heidelberg). Z. Astrophys., 67: 131-8(1967). (In German).

The distribution of the OB stars of the Heidelberg catalogue along the southern Milky Way was studied. Twenty-one OB groups with significant concentration seem to be present. For these groups mean distances were derived. In order to decide between spatial unity and mere accumulation on the sphere the dispersion of the distances was investigated and shown to be much smaller for the individual members of OB groups than for OB field stars. The spiral arm filaments can more precisely be located by the OB groups than by individual OB stars. (auth)

46112 ON THE NON-EXISTENCE OF CLUSTERS OF CLUSTERS OF GALAXIES. III. Karpowicz, Maria (Warsaw Univ.). Z. Astrophys., 67: 139-42(1967).

In continuation of the investigations of Zwicky and Rudnicki, 1966, and Karpowicz, 1967, the distribution of clusters of galaxies is analyzed as they are listed in volume V of the Catalogue of Galaxies and Clusters of Galaxies of Zwicky, Karpowicz and Kowal, 1965. The results of this analysis confirm those previously published. The distribution of the clusters of galaxies seems to be random and almost uniform. No indications were found for the existence of any systematic physical superclustering. (auth)

46113 RIOMETER OBSERVATIONS IN THE POLAR CAPS OF SOLAR COSMIC RAY EVENTS DURING THE IQSY. Goedeke, A. D.; Masley, A. J.; Adams, G. W. (Douglas Missile and Space Systems Div., Santa Monica, Calif.). Solar Phys., 1: 285-94 (Mar. 1967).

During the period of the IQSY, January 1964 through December 1965, the Sun remained quiet, accelerating few energetic particles. There were many instances during the IQSY when low-energy detectors on satellites and space probes registered small intensity increases. However, few of these "events" were associated with protons of energies exceeding 10 MeV. Moreover, the maximum intensities ($E_p > 500$ keV) were typically 1 to 8/cm^{2}sec ster. Most of these events were below the threshold of riometer detection. The largest solar cosmic-ray event observed in 1964 by polar-based riometers was that of March 16. This event was observed by 30- and 50-Mc riometers at McMurdo Sound, Antarctica, and Shepherd Bay, N.W.T., Canada. The largest event in 1965 occurred on February 5 and was the largest during the IQSY. It was associated with a class-2 flare at about 1750 UT, February 5. The propagation time between the Sun and Earth was about one hour. This event was well observed by satellites, space probes, and riometers. This paper discusses primarily the February 5, 1965, event. Some discussion is also given to the March 16, 1964 event, other small events during the IQSY, and the recent event in March 1966. (auth)

46114 ANISOTROPIC DIFFUSION OF SOLAR COSMIC RAYS. Burlaga, Leonard Francis. Minneapolis, Univ. of Minnesota, 1966. 85p.

Thesis.

A mathematical model is presented and a relatively simple solution is obtained which describes the basic characteristics of solar cosmic-ray propagation. The model postulates that solar cosmic rays diffuse anisotropically in the interplanetary medium because of the irregular spiral interplanetary magnetic field. It is assumed that the diffusion coefficient along the field direction is constant up to a distant r_1. It is assumed that beyond r_1, which is found to be approximately 2 AU for every event examined, the mean free path is essentially infinite, so that there is effectively a perfectly absorbing boundary at r_1. It is assumed that the diffusion coefficient perpendicular to the field lines increases with distance from the Sun because of the diminishing magnetic field intensity. It is shown that the particles may be considered to be ejected instantaneously from the flare. The solution of the diffusion equation with these conditions shows that the shape of the intensity versus time profile and the time to maximum intensity depend on the position of the flare. It is shown that the data for several events for which unambiguous data are available are accurately described by this solution. It is demonstrated that the solution of the diffusion equation does apply during the anisotropic phase of several events. The model is consistent with several east–west effects which have been observed. (Disser. Abstr.)

46115 THE LUMINOSITY FUNCTION OF THE M DWARF STARS. Sanduleak, Nicholas. Cleveland, Case Inst. of Tech., 1965. 156p.

Thesis.

An objective-prism survey was made of a 120 square-degree region of sky surrounding the north galactic pole. The M-type stars in this area were detected through the use of red and infrared spectroscopic plates taken with the Burrell Schmidt telescope. Late-type M stars as faint as the 17th visual magnitude were recorded on these long-exposure plates. Arguments are given to support the hypothesis that nearly all of these stars are M dwarfs, i.e., main sequence objects. The number of stars found (nearly 1300) greatly exceeds the number expected from existing luminosity function determinations. Thus, faint, red stars appear to be over twice as numerous as previously supposed. The estimated space density of all M dwarfs is 0.20 stars per cubic parsec. Their mass density, of about .042 solar masses per cubic parsec, accounts for about one-third of the total mass observable in the solar neighborhood. (Disser. Abstr.)

46116 INTERSTELLAR EXTINCTION IN THE ORION ASSOCIATION. Lee, Thomas Alan. Tucson, Ariz., Univ. of Arizona, 1967. 199p.

Thesis.

Photoelectric photometry, covering a spectral region from $\lambda = .36\ \mu$ to $3.4\ \mu$, was obtained for a large sample of early-type stars in the I Orion association with the photometric telescopes of the Lunar and Planetary Laboratory of the University of Arizona. The observations are interpreted in terms of the interstellar extinction phenomenon. The color excesses of the stars are calculated from the observed (reddened) and intrinsic (unreddened) color indices. Normalized curves revealing the wavelength dependence of the extinction and then computed. Because of the low reddening in many parts of the association, the errors of the extinction curves are often large. For this reason, regional mean extinction laws are determined from the data of individual stars in localized areas. A method that eliminates the use of filter effective wavelengths is then employed to obtain the corresponding monochromatic extinction laws. (TSS)

46117 EVOLUTION OF GALAXIES AND ITS SIGNIFICANCE FOR COSMOLOGY. Tinsley, Beatrice Muriel Hill. Austin, Tex., Univ. of Texas, 1967. 123p.

Thesis.

Evolution of the content and light of galaxies are studied to determine their significance for cosmology. A numerical computation of evolution stars from gas with Population I composition; then stars are formed at all times, at rates which are functions of stellar mass and mass of gas in the galaxy. Discrete time steps of 10^9 years are used, and 13 stellar masses. The stars are placed on the H–R diagram according to their masses and ages: each star finally becomes a white dwarf, while its excess mass enriches the interstellar gas. Different evolutionary sequences are constructed by adjusting four parameters of a stellar birthrate function. Then "galaxies" resulting from each sequence of 10 to 12×10^9 years are compared with observed local galaxies, with respect to colors in Johnson's 8-color (UBVRIJKL) system, mass/light ratio, relative mass of gas, and types of stars contributing to the light. "Galaxies" closely resembling all normal types, Im to E, can be formed with a stellar birthrate proportional to the inverse square to stellar mass, and to the mass of gas in the galaxy; the types differ in initial rate of gas consumption and in the birthrate of very low mass stars. These types can all have the same age, and do not form an evolutionary sequence. Theoretical magnitude–red shift relations (m–z) are constructed, for a variety of cosmological models, using the computed past history of giant elliptical systems. Three values of Hubble's constant are considered, since effects of evolution are greater if this is small. The color–red shift relation is also discussed, but effects of evolution are small in the range observed. Inclusion of galactic evolution greatly reduces the differences in m–z relations between models. This is because those models with the greatest luminosity distance at a given redshift also have the greatest light travel time, so the galaxies would be seen earlier when they were brighter. Many cosmological models are found to be consistent with the observed $m_v - z$ relation, including models also consistent with empirical limits on the mean density of matter, with the minimum age of the universe inferred from evolution of star clusters, and with a steep number-flux density relation for radio sources. (Disser. Abstr.)

46118 PERTURBATIONS OF A COSMOLOGICAL MODEL AND ANGULAR VARIATIONS OF THE MICROWAVE BACKGROUND. Wolfe, Arthur Michael. Austin, Tex., Univ. of Texas, 1967. 93p.

Thesis.

General relativistic, spatially homogeneous and isotropic $k = 0$ models with either pressure zero or pressure $\frac{1}{3}$ the energy density are considered. The equations for general linearized perturbations away from these models are explicitly integrated to obtain density fluctuations, rotational perturbations, and gravitational waves. The equations for light rays in the perturbed models are integrated. The models are used to estimate a lower limit on the anisotropy of the microwave radiation, assuming fluctuations now of order 10% with characteristic lengths now of order 1,000 megaparsecs would cause anisotropies of order 1% in the observed microwave temperature due to the gravitational red shift and other general relativistic effects. An interpretation of the mass of the density perturbations of the relatively increasing type of the $p = 0$ models is given. The $p = 0$ models are compared in detail with corresponding Newtonian models and the similarities are surprising. (Disser. Abstr.)

46119 UBV PHOTOMETRY OF DQ CEPHEI. Jenks, Robert Leroy. Stillwater, Okla., Oklahoma State Univ., 1966. 194p.

Thesis.

The variable star, DQ Cephei, was observed photoelectrically on five nights in 1964 with the 24-inch Seyfert telescope at the Dyer Observatory. The observations were reduced to standard U, B, V values and the light curves were obtained. The epochs of maximum and minimum light obtained from the light curves were combined with previously observed epochs to determine a refined period. The modulation envelope of the light curve was extracted to determine a beat period and a periodogram analysis of the curve was made to find a secondary period. The position of the typical short-period pulsating-variable loop in the (B–V), (U–B) diagram was examined. Computer programs were designed which could perform several of the required computations. The light curves clearly show changes in amplitude from cycle to cycle. The range in amplitude in V was from 0.04 to 0.10 magnitude. The curves show that the star is brightest when bluest, but no clearly demonstrable phase shift was observed between the colors. An unambiguous primary period was found using data spanning the interval from 1952 to 1964 and no secular variation was detected. Both the modulation envelope and periodogram analysis suggest a secondary period in fair agreement with one detected by Fitch and Wehlau, but no evidence of one reported by Sahade, Struve, Wilson, and Zebergs, based upon radial velocity measurements, was detected. The (B–V), (U–B) diagram suggests this variable may be slightly reddened. (Disser. Abstr.)

46120 INFLUENCE OF A MAGNETIC FIELD ON STELLAR ACCRETION. Burns, Joseph Arthur. Ithaca, N. Y., Cornell Univ., 1966. 101p.

Thesis.

The stellar accretion theory of Hoyle, Lyttleton, and Bondi is extended to include the possibility of the star having a magnetic field. The external field of the star is represented by a gravitational and magnetic monopole located at the center of the star and the star is considered to be moving into a uniform semi-infinite cloud of hydrogen atoms, which are un-ionized at large distances from the star. The star's radiation spectrum is represented by a Planckian distribution, given by the surface temperature of the star. The trajectory of an individual charged particle is calculated for the given magnetic–gravitational field. The particles are found to move on the surfaces of very thin cones and, if they have not yet recombined, are reflected away

Large-scale H-alpha movies of the large spot group of Sept. 13–26, 1963, together with radio, ionospheric, and magnetic field data as well as white light pictures were analyzed. The evolution of the group and associated magnetic fields is followed, and the positions of solar flares relative to the fields are noted, along with their morphology. Although the magnetic field is deformed in time, characteristic field structures may be traced through the deformation as the seat of recurrent homologous flares. It was found that most flares are homologous, and some are triggered by disturbances elsewhere in the region. Events produced by surges falling back to the surface are noted, and one flare initiated by a bright bead seen to fly across the region. In almost every case of an isolated type-III radio burst, a corresponding H-alpha brightening could be found, but not all flares produced bursts. Flares close to the sunspots are most likely to produce radio bursts. Flare surface waves in the region all travel out to the west, because of more open magnetic field structure there. In one case (Sept. 25) a wave is turned back by the closed field structure to the east. In almost all cases the time association of radio or ionospheric events is with the beginning of the flare or with the flash phase. Several morphological classes of flares are noted as recurrent types. (auth)

46084 DIFFERENCE OF THE CHROMOSPHERIC BACKGROUND INTENSITY BETWEEN THE EQUATORIAL AND POLAR REGIONS OF THE SUN. Macris, C. J. (Astronomical Inst., Athens). Solar Phys., 1: 101-6(Jan. 1967).

Small chromospheric emission centers (here defined as flocculi) were studied photometrically on $K_{2,3,2}$ spectroheliograms taken at the Arcetri Observatory. The intensity ratio between I_{fl}, the flocculus brightness, and I_{chr}, the brightness of the chromospheric background, was determined. A difference was found between the polar and the equatorial limb values of the ratio I_{fl}/I_{chr}. (auth)

46085 ON THE 11-YEARS CYCLE OF SOLAR ACTIVITY. Gnevyshev, M. N. (Pulkovo Observatory, Academy of Sciences, USSR). Solar Phys., 1: 107-20(Jan. 1967).

Each 11-year cycle of solar activity consists of two processes with different physical properties. The variety of shapes of the 11-year curves depends on the way these processes overlap. All events in the photosphere, chromosphere, and corona, and all kinds of emissions like the radio and corpuscular emissions take part in these two processes. Events taking place in the magnetosphere, ionosphere, and troposphere, and perhaps some chemical and biological events reflect the essential properties of the 11-year cycle. (auth)

46086 OBSERVATION OF THE S COMPONENT OF THE SOLAR RADIO EMISSION BY AN EIGHT ELEMENT GRATING INTERFEROMETER AT 17 Gc/s. Tsuchiya, Atsushi; Nagane, Kiyoshi (Tokyo Univ.). Solar Phys., 1: 121-4(Jan. 1967).

The slowly varying components (S components) of the solar radio emission were observed by a 17-Gc grating interferometer. In combination with 4-Gc data, it is deduced that the source of the 17 Gc S component is optically thin. (auth)

46087 GLANCING-INCIDENCE SOLAR TELESCOPE FOR THE SOFT X-RAY REGION. Underwood, J. H. (National Academy of Sciences/National Research Council, Washington, D. C.); Muney, W. S. Solar Phys., 1: 129-44(Jan. 1967).

The instrumentation of an Aerobee rocket (NASA 4.95 GS) which was launched from White Sands Missile Range on May 20, 1966, to observe the Sun in the soft x-ray region is described. The experiment package, which was pointed at the Sun by a control system stabilized about all three axes, carried two Wolter type-I glancing-incidence telescopes to photograph the Sun in wavelength regions (determined by bandpass filters) between 3 and 75 Å, and two proportional counters to obtain flux data and rough spectral shapes in the regions 2 to 11 Å and 8 to 20 Å. The spatial resolution obtained was about 20 arc seconds. Limb brightening and polar darkening are very pronounced at the longer wavelengths. A tuft of emission was observed at the North Pole in addition to an arch-like structure on the NW limb. Several of the photographs are presented, and some preliminary results are discussed. (auth)

46088 RECONNECTION OF MAGNETIC FIELD OF ACTIVE REGIONS BY THE INTERACTION OF THEIR EXTENSIONS IN INTERPLANETARY SPACE. Gopasyuk, S.; Krivsky, L. (Astronomical Inst., Czechoslovak Academy of Sciences, Ondrejov). Solar Phys., 1: 145-7(Jan. 1967).

When identifying glares connected with Forbush effects in cosmic radiation, on the basis of the hypothesis of the interplanetary magnetic bottle, it has been found that Forbush decreases are occasionally even possible when the flare source is located near the eastern limb. In the suggested model of this phenomenon, there occurs in space an interaction of drawn-out magnetic fields of solar origin from widely separated active regions, which interact and are connected according to Sweet's (1958) mechanism. On the basis of Syrovatskii's (1966) criterion this process of conjunction will be highly effective and will lead to the formation of a very large magnetic bottle. (W.D.M.)

46089 AMPLITUDE DISTRIBUTIONS OF SOLAR PHOTOSPHERIC FLUCTUATIONS. Edmonds, Frank N. Jr. (Univ. of Texas, Austin). Solar Phys., 1: 5-15(Jan. 1967).

Amplitude distributions, which are nearly Gaussian, were calculated for radial velocity, continuum brightness, spectral line equivalent width, and spectral line central residual intensity fluctuations measured from high-dispersion high-resolution spectrograms taken at the center of the solar disk. The RMS and skewness S for each distribution were calculated in a manner which allows testing of the homogeneity of the granulation pattern (i.e., variations in its statistics across the solar disk and with time). Pattern inhomogeneity across the disk is strongly indicated, and further evidence suggesting appreciable pattern persistence over time intervals $\gtrsim$15 minutes is presented. The possibilities for investigations of S and its associated bi-spectrum are discussed. The qualitative values of S obtained are shown not to be due to unusually bright, rising granules (though a statistical tendency towards such granules is possible). An attempt to explain S for continuum brightness fluctuations in terms of the nonlinear effects of Planckian emission and opacity fluctuations in a stratified photosphere, leads to contradiction with the measured amplitude distributions, a contradiction which is probably due to an oversimplified treatment of radiative transfer in an inhomogeneous photosphere. (auth)

46090 THE SAGAMORE HILL SOLAR RADIO OBSERVATORY AND THE EVENT OF AUGUST 28, 1966. Castelli, J. P. (Air Force Cambridge Research Labs., Bedford, Mass.); Michael, G. A. Solar Phys., 1: 125-8(Jan. 1967).

A brief description is presented on the brilliant solar flare which occurred on August 28, 1966. A proton event began about an hour after the flare. PCA X/1DB was reported. The geomagnetic storm starting at 13:14 U.T. on August 29 was probably caused by the flare. (W.D.M.)

46091 REMARKS ON POSSIBLE CONNECTION BETWEEN COSMOLOGY AND ATOMIC PHYSICS. Ivanenko, D. (Moscow Univ.). Wiss. Z. Friedrich-Schiller-Univ. Jena, Math.-Naturwiss. Reihe, 15: 167(1966).

An evaluation of the mass of a graviton from Einstein equations with cosmological terms is compared with $^2H = \lambda = (m_{gr}c^2/\hbar)^2$. Attempts can be made to evaluate the mass of a graviton extending the well-known empirical relation between masses of protons and electrons and constants of strong and electromagnetic coupling to ultraweak gravitational interactions. Two fundamental features of the real universe are considered: its expansion and overwhelming preponderance of particles over antiparticles, which may not be independent of one another. It is conjectured that due to expansion of the universe there is no strong T parity conservation and no CP conservation. These concepts are applied to recently discovered T nonconservation at $K_2^0 \to 2\pi$ decay. Possibly real inversion may consist not only in supplementing space inversion by transition to antiparticles, but also by transition from an expanding to a contracting universe. The effect of expansion (or contraction) is considered as a rough approximation as an influence of a cosmological force acting differently on particles and antiparticles, i.e. K^0 and $\bar{K}^0$. Due to the influence of such a highly hypothetical ultra-ultra-weak cosmological force, K_2^0 mesons may appear as a mixture of previously pure local $(K_2^0)_0$ and $(\bar{K}_1^0)_0$. Other concepts which may establish links between cosmological and quantum elementary processes are considered. (BBB)

46092 SOLAR FLARES AND CHEMICAL PHENOMENA. Piccardi, Giorgio (Univ., Florence). Geofis. Meteorol. (Genoa), 16: 11-12(Jan.-Apr. 1967).

The correlation of 2 chemical tests (so-called F and P tests) for solar–geomagnetic activity with proton flare data is discussed. The correlation is based on results of automated and standardized chemical tests performed for over 15 yr, with more than 40,000 numerical data recorded in Florence as well as other data recorded all over the world, in both hemispheres. These ~40,000 data form a homogeneous unit, by which statistical analysis can be made. The numerical values from these tests fluctuate in the course of time, and these fluctuations enabled a relation between the tests and solar activity to be detected. Test F results show a sharp peak in connection with the day of the solar eruption. By synchronizing the proton flare data with test P data (which seemed to respond more intensely than the other test to these flares), a marked effect during periods of great solar activity was noted. One instance of correlation of test P data with a recent solar flare is examined in detail. (BBB)

46093 COSMIC POSITION OF QUASISTELLAR RADIO SOURCES. Schmeidler, Felix (Univ., Munich). Naturwiss. Rundsch., 20: 93-5(Mar. 1967). (In German).

The most recent proposals on the nature of quasars are reviewed and criticized. Particular attention is devoted to the local hypothesis of McCrea and of Hoyle and Burbidge, and to McCrea's comparison of the special relativity, de Sitter, and Friedmann models of the Universe with respect to the location of radio sources, in which the special relativity model was shown to give the most reasonable result. Hoyle and Burbidge's argument based on the magnitude of the inverse Compton effect is also reviewed, as well as their explanation of the redshift. Comments on the periodicity of the sources are made. Future experimentation and observation are necessary to confirm the local hypothesis. (BBB)

46094 ABUNDANCE DETERMINATIONS FROM STELLAR SPECTRA. Cayrel, R.; Cayrel de Strobel, G. (Observatoire de Paris, Meudon, France). Annu. Rev. Astron. Astrophys., 4: 1-18(1966).

This review (116 references) reveals that about 300 stars showing at least 10 different types of abundance peculiarities have been studied, chiefly during the last 5 yr. The principal value of abundance determinations from stellar spectra is the clues they give to the nuclear history of stellar matter and, more generally, of the matter in the whole Galaxy. The following topics are reviewed: critical analysis of the methods used to obtain the abundances, metals-to-hydrogen ratio, lithium abundance, helium stars, and barium stars. The interpretation of the abundances found in stellar atmospheres is discussed. A real abundance peculiarity is not necessarily the consequence of a nuclear process; other processes may be able to alter the chemical composition of a stellar atmosphere. Model-atmosphere analysis is examined, as well as the nonlocal thermodynamic equilibrium controversy. The metals-to-hydrogen ratio in various stars are tabulated. The lithium abundance, which shows a considerable spread in otherwise normal F and G stars, is discussed. It is concluded that the bearing of abundance determinations on a full understanding of stellar evolution and the nuclear history of the Galaxy is becoming more and more obvious. Some questions needing further investigations are considered. (BBB)

46095 INFLUENCE OF THE MAGNETIC FIELD ON THE FLUX OF RADIO EMISSION FROM SOURCES ASSOCIATED WITH SUNSPOT GROUPS. Abbasov, A. R. (Leningrad State Univ.). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 129-30(1967).

Translated from Geomagn. Aeronomiya, 7: 170-1(1967).

Previous investigations indicate that the synchrotron mechanism plays an important role in the emission of sources above sunspot groups in the centimeter range. In such a case the magnetic field intensity in a group must have a substantial effect on the radio noise flux from the source. The results of a study relating to 3.2- and 7.5-cm waves are reported to elucidate the characteristics and degree of this relationship. (J.H.M.)

46096 NATURE AND GEOPHYSICAL EFFECTIVENESS OF AGENTS RESPONSIBLE FOR TYPE II AND IV SOLAR RADIO BURSTS. Fomichev, V. V.; Chertok, I. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radiowave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 1-3(1967).

Translated from Geomagn. Aeronomiya, 7: 3-6(1967).

By statistical analysis of the agents responsible for type-II and -IV radio bursts, it is shown that the rather high velocity of a plasma blob ejected from the region of a chromospheric flare and the intensity of its internal magnetic field are mutually independent phenomena. An attempt is made on this basis to analyze the relationship between type-II and -IV radio bursts and to determine the properties of the agents producing each of these two types of bursts. (auth)

46097 ISOTROPIC GAMMA-RAY INTENSITY IN AN EXPANDING UNIVERSE. Cheng, Chung-chieh (Harvard Coll. Observatory, Cambridge, Mass.). Nature (London), 215: 1035-8(Sept. 2, 1967).

The intensities of isotropic gamma rays produced by the inverse Compton process in an expanding universe are calculated, including the effect of red shift on the radiation field. The results may give information concerning the universal black-body radiation field and the intergalactic electron flux intensity. (auth) (UK)

46098 OBSERVATIONS OF SMALL-SCALE SOLAR MAGNETIC FIELDS. Sheeley, N. R. Jr. (Kitt Peak National Observatory, Tucson, Ariz.). Solar Phys., 1: 171-9(Mar. 1967).

Spectrograms, obtained during moments of good seeing with the high spatial resolution afforded by the 80-cm solar image at the Kitt Peak National Observatory, show the following: (1) Magnetic fields of several hundred gauss occur in tiny areas easily as small as 500 km in extent in regions of the solar surface sometimes well removed from areas of sunspot activity. (2) In these tiny areas of magnetic field, many Fraunhofer lines seem to be weakened, appearing on spectrograms as discontinuities or gaps in the absorption lines. (3) Although the small-scale magnetic fields are manifested by local weakenings of many absorption lines, these fields often correspond to local darkenings in the continuum, suggesting that the small-scale fields often occur in the dark lanes and pores of the granulation. (4) These tiny areas of relatively strong magnetic field correspond to regions of bright Ca^+ K_{1v} emission, not to the so-called K_{2v} bright points seen on spectroheliograms. It is implied that these relatively strong fields associated with the weakenings or gaps in Fraunhofer lines are precisely the fields detected using Leighton's photographic technique. (auth)

46099 EVIDENCE OF SOLAR GRANULATION AT 2000 A. Blamont, J. E.; Carpentier, G. (CNRS, Verrieres-le-Buisson, France). Solar Phys., 1: 180-90(Mar. 1967). (In French).

Eight ultraviolet monochromatic pictures at the limb of the sun are analyzed for evidence of granulation in this spectral range (λ = 2000 Å). The spectral window (125 Å) is defined by two interference filters. These high-resolution pictures were obtained with a 20-cm Cassegrain telescope carried at 30,500 m of altitude by a stratospheric balloon. The resolution of the telescope is 1 sec. The instrument is mounted on a Sun-pointing control of excellent short time stability (2 sec). The pictures were taken at intervals of 210 seconds with a 0.25-second exposure. Large brilliant irregularities 10 to 20 sec in width are interpreted as chromospheric microfaculae with a half-hour lifetime. On the other hand, the smaller irregularities are interpreted as ultraviolet granulation. Using the correlation and structure functions, the analysis of the density distribution shows that spatial correlation of these irregularities is limited to a 4-sec range. (auth)

46100 MODEL OF THE INHOMOGENEOUS CHROMOSPHERE OF THE SUN. Krat, V. A. (Pulkovo Observatory, Academy of Sciences, USSR). Solar Phys., 1: 191-203(Mar. 1967).

A new model is proposed for the solar chromosphere, which is assumed to be an instable inhomogeneous formation, consisting of numerous elements (filaments), each with different temperature and density. Fluctuations of the magnetic field may give rise to chromospheric turbulence and may also cause the chromospheric inhomogeneities. (auth)

46101 MOTIONS OF CHROMOSPHERE FINE STRUCTURE IN A WEAK PLAGE. Zirker, J. B. (Univ. of Hawaii, Honolulu). Solar Phys., 1: 204-15(Mar. 1967).

Motions in an old center of activity were studied at the limb with the use of time-resolved Hα spectra. The observations were made at intervals of 5 seconds over a period of $\frac{3}{4}$ hour of good seeing at Sacramento Peak Observatory. Objects in this region have larger line-of-sight velocities than have been reported for spicules in quiet regions. Velocities as high as 70 km/sec were observed; 17% of a sample of 200 instantaneous velocities exceed 30 km/sec. The line-of-sight velocities of 20 objects were measured as a function of time. For 5 of these, transverse velocity components could also be estimated. A single pattern, such as the simple rise without fall reported by Mouradian, does not exist. The motion is often quite complex, involving lateral expansion, shear, and occasionally, splitting. Reversal of sign of the velocity is not uncommon. (auth)

46102 VARIABILITY OF THE INTEGRATED SOLAR K LINE EMISSION. Bumba, V.; Ruzickova-Topolova, B. (Astronomical Inst., Czechoslovak Academy of Sciences, Ondrejov). Solar Phys., 1: 216-19(Mar. 1967).

The preliminary results seem to demonstrate the facts that the Sun observed as a star in the light of the K and H lines is variable, and that this variability is closely related to that of the magnetic field intensity, or to the distribution of magnetic fields, and hence to the distribution of calcium plages or photospheric faculae in the solar atmosphere. This variability will not so much be related to the variation of Wolf's relative sunspot numbers or to the variation of the sunspot area. The applicability of the obtained results for the examination of the late-type stars seems to be evident. (auth)

46103 CURRENTS IN THE SOLAR ATMOSPHERE AND A THEORY OF SOLAR FLARES. Alfven, H.; Carlqvist, P. (Royal Inst. of Tech., Stockholm). Solar Phys., 1: 220-8(Mar. 1967).

Topics discussed include definition of the electromagnetic state, measurements of magnetic fields and currents, description of the electromagnetic state by the current system, circuit interruption, maximum current through a plasma, disruption of the current, instability of a current in a completely ionized gas, applications to solar conditions, qualitative picture of solar flare, and quantitative considerations. (W.D.M.)

46104 SOLAR ABUNDANCE DETERMINATION FROM ULTRAVIOLET EMISSION LINES. **Dupree, Andrea K.; Goldberg, Leo (Harvard Coll., Cambridge, Mass.). Solar Phys., 1: 229-41(Mar, 1967).**

The intensities of far ultraviolet emission lines from the solar corona are analyzed to determine relative coronal abundances for oxygen, silicon, and iron. Dielectronic recombination is included in the formulation of ionization equilibrium. Observations of solar radio emission are used to obtain abundances relative to hydrogen. The absolute coronal abundances appear to be in agreement with their respective photospheric values. General properties of the structure of the chromosphere and corona are deduced from the analysis of observed emission in the ultraviolet and radio wavelength regions. (auth)

46105 DISTRIBUTION OF THE 9-CM RADIO EMISSION OVER THE SOLAR DISK DURING THE SUNSPOT MINIMUM. **Roosen, J.; Goh, T. (Utrecht Univ. Netherlands Foundation for Radio Astronomy, Utrecht). Solar Phys., 1: 242-53(Mar. 1967).**

The brightness distribution of the quiet Sun at 9.1 cm was determined from the Stanford pencil-beam radioheliograms for three periods in the recent solar activity minimum, centered at July 15 and September 15, 1964 and at April 5, 1965. The brightness maxima near the limbs are not symmetric with respect to the central meridian, but are situated at 76°E and 66°W longitude, respectively. On the disk, the brightness temperature is likewise distributed asymmetrically, but the direction of this asymmetry changes as the new cycle starts. The asymmetries are tentatively explained by assuming the presence of inhomogeneous streamers in the solar atmosphere, which are tilted by the solar rotation. The eastward shift of the limb maxima with respect to the optical disk is confirmed by the 21-cm heliograms obtained at Fleurs near Sydney, Australia. (auth)

46106 INTERACTION OF THE SOLAR WIND WITH A COMET. **Biermann, L.; Brosowski, B.; Schmidt, H. U. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Solar Phys., 1: 254-84(Mar, 1967).**

The flow of plasma on the sunward side of a comet is investigated by means of an axial-symmetric model based on hydrodynamics modified by source terms. The model assumes a given curvature of the isobaric surfaces, which corresponds to paraboloids around the nucleus of the comet. The flow on the axis can be represented by a solution of a system of seven ordinary differential equations. The flow pattern always contains a widely detached bow shock and a contact discontinuity separating a cavity with purely cometary plasma from the transition region containing also solar wind ions. The model is applied to the special case where the cometary gas is ionized by the solar uv radiation only. Numerical solutions are integrated for five levels of production of neutral gas by the comet and for seven typical situations in the undisturbed solar wind. The results imply standoff distances of the stagnation point from the nucleus of the order of 10,000 km or more, and distances of the bow shock of the order of 10^6 to 10^7 km. (auth)

46107 C I AND CH LINES IN SOLAR SPECTRUM. **Baschek, B.; Holweger, H. (Neue Univ., Kiel). Z. Astrophys., 67: 143-54(1967). (In German).**

An investigation of 25 solar lines of CH($A^2\Delta - X^2\Pi$) near λ 4300 was carried out for two positions on the solar disk ($\cos\vartheta = 1$ and 0.3). The line profiles were computed by direct integration of intensities using the solar model by Holweger, 1967. From these lines $\log g_e f_e \epsilon_C = 6.66$ for $\cos\vartheta = 1$ and 6.58 for $\cos\vartheta = 0.3$ were calculated. There is no evidence of departures from LTE for the CH lines. With the carbon abundance $\log \epsilon_C = 8.51$ as derived from atomic C I lines, the solar f value of the $A^2\Delta - X^2\Pi$ transition of CH: $\log f_e = -2.45$ was determined. The excitation temperature of the CH lines was found to be approximately $T_{exc} = 5200°K$. (auth)

46108 DETERMINATION OF THE ABUNDANCE RATIO $^{12}C/^{13}C$ IN SOLAR ATMOSPHERE. **Richter, Johannes; Tonner, Karl-Friedrich (Neue Univ., Kiel). Z. Astrophys., 67: 155-64(1967). (In German).**

The wavelengths of lines belonging to the violet (0,0) bands of the molecules ^{12}CN, ^{13}CN, ^{12}CH, and ^{13}CH were measured. Several pairs of relatively undisturbed isotopic $^{12}CH - ^{13}CH$ rotational lines could be identified in the solar spectrum. From their equivalent widths a solar abundance ratio $^{12}C/^{13}C = 100 \pm 30$ can be derived. (auth)

46109 SIMPLE MODEL FOR GRAVITATIONAL COLLAPSE WITH PRESSURE GRADIENT. **Nariai, Hidekazu (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto), 38: 92-106(July 1967).**

A simple model for gravitational collapse with pressure gradient, but without energy flow, is investigated within the framework of general relativity. The model is regular at all times throughout the entire region in such a way that all interior events can send signals to external observers. The mass-radius relation of the model provides us with the inequality $GM/c^2R_b < 0.375$, which is comparable with the analogous ones due to Buchdahl and Bondi for static fluid spheres. The usual assumption of quasi-static equilibrium is, however, prohibited in the model, because its fluid velocity can attain about one-tenth the speed of light. The gravitational potential and binding energies are calculated, but the result for the latter, i.e., B. E. = 0, is not unique. The spectral shift of a light or neutrino ray to be received by an external observer is also analyzed, whose formula is an extension of the previous one in the case of gravitational collapse or anticollapse with uniform density and negligible pressure. (auth)

46110 THE CORONA AT THE TOTAL SOLAR ECLIPSE OF 1952 FEBRUARY 25. II. THE LINE SPECTRUM. **Falchi, A.; Falciani, R.; Rigutti, M. (Osservatorio Astrofisico di Arcetri, Florence). Z. Astrophys., 67: 115-22(1967).**

The coronal line spectra obtained at the eclipse of 1952 have been studied. These spectra show also the line at λ 6916 Å whose presence in the coronal spectrum was noted for the first time by Wlérick and Fehrenbach in 1963. The energies emitted in the lines are given. No use is made of the hypothesis of spherical symmetry of the corona. Instead, ions with ionization potentials of the same order of magnitude or ions which can surely coexist in a given coronal region can be considered as isothermic. Relative abundances of Ni and Fe can be determined without making any "a priori" assumptions. A comparison is made with earlier determinations. (auth)

46111 OB STAR GROUPS IN THE SOUTHERN MILKY WAY. **Klare, Gerhard (Mitteilungen der Landesternwarte, Heidelberg). Z. Astrophys., 67: 131-8(1967). (In German).**

The distribution of the OB stars of the Heidelberg catalogue along the southern Milky Way was studied. Twenty-one OB groups with significant concentration seem to be present. For these groups mean distances were derived. In order to decide between spatial unity and mere accumulation on the sphere the dispersion of the distances was investigated and shown to be much smaller for the individual members of OB groups than for OB field stars. The spiral arm filaments can more precisely be located by the OB groups than by individual OB stars. (auth)

46112 ON THE NON-EXISTENCE OF CLUSTERS OF CLUSTERS OF GALAXIES. III. **Karpowicz, Maria (Warsaw Univ.). Z. Astrophys., 67: 139-42(1967).**

In continuation of the investigations of Zwicky and Rudnicki, 1966, and Karpowicz, 1967, the distribution of clusters of galaxies is analyzed as they are listed in volume V of the Catalogue of Galaxies and Clusters of Galaxies of Zwicky, Karpowicz and Kowal, 1965. The results of this analysis confirm those previously published. The distribution of the clusters of galaxies seems to be random and almost uniform. No indications were found for the existence of any systematic physical superclustering. (auth)

46113 RIOMETER OBSERVATIONS IN THE POLAR CAPS OF SOLAR COSMIC RAY EVENTS DURING THE IQSY. **Goedeke, A. D.; Masley, A. J.; Adams, G. W. (Douglas Missile and Space Systems Div., Santa Monica, Calif.). Solar Phys., 1: 285-94 (Mar. 1967).**

During the period of the IQSY, January 1964 through December 1965, the Sun remained quiet, accelerating few energetic particles. There were many instances during the IQSY when low-energy detectors on satellites and space probes registered small intensity increases. However, few of these "events" were associated with protons of energies exceeding 10 MeV. Moreover, the maximum intensities ($E_p > 500$ keV) were typically 1 to 8/cm^{2}sec ster. Most of these events were below the threshold of riometer detection. The largest solar cosmic-ray event observed in 1964 by polar-based riometers was that of March 16. This event was observed by 30- and 50-Mc riometers at McMurdo Sound, Antarctica, and Shepherd Bay, N.W.T., Canada. The largest event in 1965 occurred on February 5 and was the largest during the IQSY. It was associated with a class-2 flare at about 1750 UT, February 5. The propagation time between the Sun and Earth was about one hour. This event was well observed by satellites, space probes, and riometers. This paper discusses primarily the February 5, 1965, event. Some discussion is also given to the March 16, 1964 event, other small events during the IQSY, and the recent event in March 1966. (auth)

46114 ANISOTROPIC DIFFUSION OF SOLAR COSMIC RAYS. **Burlaga, Leonard Francis. Minneapolis, Univ. of Minnesota, 1966. 85p.**

Thesis.

A mathematical model is presented and a relatively simple solution is obtained which describes the basic characteristics of solar cosmic-ray propagation. The model postulates that solar cosmic rays diffuse anisotropically in the interplanetary medium because of the irregular spiral interplanetary magnetic field. It is assumed that the diffusion coefficient along the field direction is constant up to a distant r_1. It is assumed that beyond r_1, which is found to be approximately 2 AU for every event examined, the mean free path is essentially infinite, so that there is effectively a perfectly absorbing boundary at r_1. It is assumed that the diffusion coefficient perpendicular to the field lines increases with distance from the Sun because of the diminishing magnetic field intensity. It is shown that the particles may be considered to be ejected instantaneously from the flare. The solution of the diffusion equation with these conditions shows that the shape of the intensity versus time profile and the time to maximum intensity depend on the position of the flare. It is shown that the data for several events for which unambiguous data are available are accurately described by this solution. It is demonstrated that the solution of the diffusion equation does apply during the anisotropic phase of several events. The model is consistent with several east–west effects which have been observed. (Disser. Abstr.)

46115 THE LUMINOSITY FUNCTION OF THE M DWARF STARS. Sanduleak, Nicholas. Cleveland, Case Inst. of Tech., 1965. 156p.

Thesis.

An objective-prism survey was made of a 120 square-degree region of sky surrounding the north galactic pole. The M-type stars in this area were detected through the use of red and infrared spectroscopic plates taken with the Burrell Schmidt telescope. Late-type M stars as faint as the 17th visual magnitude were recorded on these long-exposure plates. Arguments are given to support the hypothesis that nearly all of these stars are M dwarfs, i.e., main sequence objects. The number of stars found (nearly 1300) greatly exceeds the number expected from existing luminosity function determinations. Thus, faint, red stars appear to be over twice as numerous as previously supposed. The estimated space density of all M dwarfs is 0.20 stars per cubic parsec. Their mass density, of about .042 solar masses per cubic parsec, accounts for about one-third of the total mass observable in the solar neighborhood. (Disser. Abstr.)

46116 INTERSTELLAR EXTINCTION IN THE ORION ASSOCIATION. Lee, Thomas Alan. Tucson, Ariz., Univ. of Arizona, 1967. 199p.

Thesis.

Photoelectric photometry, covering a spectral region from $\lambda = .36\ \mu$ to $3.4\ \mu$, was obtained for a large sample of early-type stars in the I Orion association with the photometric telescopes of the Lunar and Planetary Laboratory of the University of Arizona. The observations are interpreted in terms of the interstellar extinction phenomenon. The color excesses of the stars are calculated from the observed (reddened) and intrinsic (unreddened) color indices. Normalized curves revealing the wavelength dependence of the extinction and then computed. Because of the low reddening in many parts of the association, the errors of the extinction curves are often large. For this reason, regional mean extinction laws are determined from the data of individual stars in localized areas. A method that eliminates the use of filter effective wavelengths is then employed to obtain the corresponding monochromatic extinction laws. (TSS)

46117 EVOLUTION OF GALAXIES AND ITS SIGNIFICANCE FOR COSMOLOGY. Tinsley, Beatrice Muriel Hill. Austin, Tex., Univ. of Texas, 1967. 123p.

Thesis.

Evolution of the content and light of galaxies are studied to determine their significance for cosmology. A numerical computation of evolution stars from gas with Population I composition; then stars are formed at all times, at rates which are functions of stellar mass and mass of gas in the galaxy. Discrete time steps of 10^8 years are used, and 13 stellar masses. The stars are placed on the H–R diagram according to their masses and ages: each star finally becomes a white dwarf, while its excess mass enriches the interstellar gas. Different evolutionary sequences are constructed by adjusting four parameters of a stellar birthrate function. Then "galaxies" resulting from each sequence of 10 to 12×10^9 years are compared with observed local galaxies, with respect to colors in Johnson's 8-color (UBVRIJKL) system, mass/light ratio, relative mass of gas, and types of stars contributing to the light. "Galaxies" closely resembling all normal types, Im to E, can be formed with a stellar birthrate proportional to the inverse square to stellar mass, and to the mass of gas in the galaxy; the types differ in initial rate of gas consumption and in the birthrate of very low mass stars. These types can all have the same age, and do not form an evolutionary sequence. Theoretical magnitude–red shift relations (m–z) are constructed, for a variety of cosmological models, using the computed past history of giant elliptical systems. Three values of Hubble's constant are considered, since effects of evolution are greater if this is small. The color–red shift relation is also discussed, but effects of evolution are small in the range observed. Inclusion of galactic evolution greatly reduces the differences in m–z relations between models. This is because those models with the greatest luminosity distance at a given redshift also have the greatest light travel time, so the galaxies would be seen earlier when they were brighter. Many cosmological models are found to be consistent with the observed $m_V - z$ relation, including models also consistent with empirical limits on the mean density of matter, with the minimum age of the universe inferred from evolution of star clusters, and with a steep number-flux density relation for radio sources. (Disser. Abstr.)

46118 PERTURBATIONS OF A COSMOLOGICAL MODEL AND ANGULAR VARIATIONS OF THE MICROWAVE BACKGROUND. Wolfe, Arthur Michael. Austin, Tex., Univ. of Texas, 1967. 93p.

Thesis.

General relativistic, spatially homogeneous and isotropic $k = 0$ models with either pressure zero or pressure $\frac{1}{3}$ the energy density are considered. The equations for general linearized perturbations away from these models are explicitly integrated to obtain density fluctuations, rotational perturbations, and gravitational waves. The equations for light rays in the perturbed models are integrated. The models are used to estimate a lower limit on the anisotropy of the microwave radiation, assuming fluctuations now of order 10% with characteristic lengths now of order 1,000 megaparsecs would cause anisotropies of order 1% in the observed microwave temperature due to the gravitational red shift and other general relativistic effects. An interpretation of the mass of the density perturbations of the relatively increasing type of the $p = 0$ models is given. The $p = 0$ models are compared in detail with corresponding Newtonian models and the similarities are surprising. (Disser. Abstr.)

46119 UBV PHOTOMETRY OF DQ CEPHEI. Jenks, Robert Leroy. Stillwater, Okla., Oklahoma State Univ., 1966. 194p.

Thesis.

The variable star, DQ Cephei, was observed photoelectrically on five nights in 1964 with the 24-inch Seyfert telescope at the Dyer Observatory. The observations were reduced to standard U, B, V values and the light curves were obtained. The epochs of maximum and minimum light obtained from the light curves were combined with previously observed epochs to determine a refined period. The modulation envelope of the light curve was extracted to determine a beat period and a periodogram analysis of the curve was made to find a secondary period. The position of the typical short-period pulsating-variable loop in the (B–V), (U–B) diagram was examined. Computer programs were designed which could perform several of the required computations. The light curves clearly show changes in amplitude from cycle to cycle. The range in amplitude in V was from 0.04 to 0.10 magnitude. The curves show that the star is brightest when bluest, but no clearly demonstrable phase shift was observed between the colors. An unambiguous primary period was found using data spanning the interval from 1951 to 1964 and no secular variation was detected. Both the modulation envelope and periodogram analysis suggest a secondary period in fair agreement with one detected by Fitch and Wehlau, but no evidence of one reported by Sahade, Struve, Wilson, and Zebergs, based upon radial velocity measurements, was detected. The (B–V), (U–B) diagram suggests this variable may be slightly reddened. (Disser. Abstr.)

46120 INFLUENCE OF A MAGNETIC FIELD ON STELLAR ACCRETION. Burns, Joseph Arthur. Ithaca, N. Y., Cornell Univ., 1966. 101p.

Thesis.

The stellar accretion theory of Hoyle, Lyttleton, and Bondi is extended to include the possibility of the star having a magnetic field. The external field of the star is represented by a gravitational and magnetic monopole located at the center of the star and the star is considered to be moving into a uniform semi-infinite cloud of hydrogen atoms, which are un-ionized at large distances from the star. The star's radiation spectrum is represented by a Planckian distribution, given by the surface temperature of the star. The trajectory of an individual charged particle is calculated for the given magnetic–gravitational field. The particles are found to move on the surfaces of very thin cones and, if they have not yet recombined, are reflected away

from the star along the same cone by a magnetic mirror effect. The exact position on the cone's surface is found from conservation of energy, as is the point of closest approach. It is further found that, in contrast to previous accretion solutions, the relative velocity between the star and the hydrogen cloud does not decrease but increases. Thus spherically symmetric accretion does not take place and linear momentum can be conserved only by including the linear momentum of the electromagnetic field, produced by the charged particles. In order to find the ionization probability for a hydrogen atom, moving in a cloud of particles toward the star, cross sections for the various possible atomic processes are calculated. It is shown that the most important atomic processes in interstellar space are photoionization and radiative recapture. Using these cross sections and the given black body spectrum, the ionization rate is given as a function of the space coordinates and integrated along a particle's orbit to give the probability of ionization. By considering all the atoms to be ionized at one radius, the ion density is calculated from a continuity equation. Since the distribution of electrons is primarily determined by collisions with protons, the electron density is given by the solution to a diffusion equation, in which the diffusion coefficient depends on the proton distribution, given as a function of the space coordinates. The rate of recapture is determined from the radiative recapture cross section and the density of ions and electrons and is shown to be small in comparison to the photoionization rate. The recombined atoms will orbit the star until they are reionized with only a small percentage striking the star's surface. (Disser. Abstr.)

46121 PRODUCTION OF ANOMALOUS ABUNDANCES BY NUCLEAR REACTIONS AT STELLAR SURFACES. Brancazio, Peter J. New York, New York Univ., 1966. 163p.

Thesis.

Analyses of stellar spectra reveal that stars will often exhibit unusually large over- and underabundances of certain elements relative to other stars of the same spectral class. The most well-known example is that of the peculiar A stars; these stars tend to have underabundances of the light elements and overabundances of as much as a factor of 100 for heavier elements, particularly in the rare-earth region. It is most probable that these abundance anomalies derive from nuclear reactions occurring at the surface of the star. These reactions are induced by the bombardment of charged particles which have been accelerated to high energies by magnetic fields in the star. A detailed calculation is made of the effect of a bombarding flux of protons and alphas on a mixture of normal stellar composition in order to determine whether large overabundances can be produced. This requires a detailed knowledge of the cross sections for all reactions that can occur as a result of proton and alpha bombardment, for all nuclear species found in a mixture of stellar composition. The statistical theory of nuclear reactions, with several modifications, is used to calculate cross sections for reactions in which up to three particles are emitted by the compound nucleus. It is found that large overabundances of heavier elements can be produced by a bombarding flux of alpha particles. In particular, it is seen that large overabundances are produced for the rare earth elements, and that these overabundances remain over a long period of bombardment. The relevance of these results to the actual conditions in an A star is considered, and a possible model is proposed. The mechanisms available in a star for the acceleration of particles to high energies is also surveyed. (Disser. Abstr.)

46122 SPACE AGE IN FISCAL YEAR 2001. Proceedings of the Fourth AAS Goddard Memorial Symposium, 15–16 March 1966, Washington, D. C. Konecci, Eugene B.; Hunter II, Maxwell W.; Trapp, Robert F. (eds.). AAS Science and Technology Series, Volume 10. A Supplement to Advances in the Astronautical Sciences. Washington, D. C., American Astronautical Society, 1967. 456p. $14.25. (CONF-660342-(Vol.10)).

Twenty papers on events and systems predicted for the space age in the year 2001 are presented. (J.H.M.)

Atomic and Molecular Physics

Refer also to abstracts 45462, 46196, 46335, 46370, 46682, 46712, 46724, 46746, and 46820.

46123 (BMwF-FBK-67-64) ELASTISCHE ENERGIEVERLUSTE VON AN FESTKOERPERN GESTREUTEN ELEKTRONEN. (Elastic Energy Losses of Electrons Scattered on a Solid). Schoenebeck, H.; Wolter, R. (Technische Universitaet, Berlin (West Germany). Physikalisches Institut (I)). July 1967. 9p. (In German). Dep.

Elastic energy losses due to scattering of medium-energy electrons (25 to 45 keV) by solids into large angles (≥45°) are experimentally and theoretically investigated. Energy losses up to a few electron volts appear, which depend on the mass of the atoms, of the scattering angle, and of the primary energy of the electrons. These results agree with the assumption of elastic scattering by single atoms and not by the solid as a whole. The width of the energy losses increases with the energy loss itself, and with the temperature of the solid. In a first theoretical approximation this effect can be explained by the thermal motion of free atoms. (auth)

46124 (N-67-25059) ELECTRON TRANSMISSION THROUGH THICK SILICON TARGETS. Singh, Jag J. (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). May 1967. 28p. (NASA-TN-D-3927). CFSTI.

Results of some recent measurements on angular and energy distribution of fast electrons transmitted through silicon targets of thicknesses varying from about 10 to 50% of the mean range are compared with theoretical calculations based on the Goudsmit–Saunderson treatment of multiple Coulomb scattering of electrons. Effects of fluctuations of collision losses of the incident electrons have been included in the theory. It is concluded that the presently available theoretical calculations predict a somewhat lower value of the width of the transmitted electron spectra than measurements indicate. (auth) (STAR)

46125 (ORNL-AMPIC-8) BIBLIOGRAPHY OF ATOMIC AND MOLECULAR PROCESSES FOR JULY–DECEMBER 1966. (Oak Ridge National Lab., Tenn.). Oct. 1967. 176p. Dep. CFSTI.

This annotated bibliography contains approximately 1700 references of interest to atomic and molecular processes research. Bibliographical sources consisted of seventy-six scientific journals and five abstract journals. The references are classified into fourteen major categories with appropriate subcategories. Each entry in the respective category is entered alphabetically and includes the reactants of the atomic and molecular system of interest. (auth)

46126 (ORNL-AMPIC-9) BIBLIOGRAPHY OF ATOMIC AND MOLECULAR PROCESSES FOR JANUARY–JUNE 1967. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. 225p. Dep. CFSTI.

This annotated bibliography contains references of interest to atomic and molecular processes research. Bibliographical sources consisted of seventy-six scientific journals and five abstract journals. The references are classified into fourteen major categories with appropriate subcategories. Each entry in the respective category is entered alphabetically and includes the reactants or the atomic and molecular system of interest. (auth)

46127 (R-67SD53) EQUATIONS OF STATE OF REAL GASES. Thomas, R. B. Jr. (General Electric Co., Philadelphia, Pa. Missile and Space Div.). Sept. 1967. 27p.

An understanding of the relationship between the basic structure and interactions of atoms and molecules composing a gas is very useful in making precise predictions about its gross thermodynamic properties under given conditions and in providing qualitative estimates of its behavior under conditions where its properties have not actually been calculated. The relationship of the basic quantum mechanical properties of atoms (including ions) and molecules to the macroscopic properties of gases composed of them is developed on the basis of quantum statistical mechanics. The concept of a perfect gas is first discussed in order to provide a framework for discussing the various interactions that occur in real gases, i.e., those having internal degrees of freedom and interactions with neighboring atoms and molecules. Considerable attention is given to the problem of an ionized gas because of the special nature of the forces between the particles composing it, i.e., long-range Coulomb interactions. The influence of level-occupation numbers on the thermodynamic properties of a plasma is treated in some detail because of the rather wide application to current problems in technology. (auth)

46128 (RHEL/R-146) ENERGY LOSS DISTRIBUTIONS OF HEAVY PARTICLES IN THICK ABSORBERS. Tschalaer, C. (Rutherford High Energy Lab., Chilton (England)). June 1967. 56p. Dep. CFSTI. UK 8s.

The energy straggling distributions of nonrelativistic heavy particles traveling through a homogeneous absorber were determined for energy losses up to about 85% of the initial energy. Included are single collision distributions for very small energy losses. The distributions are found to be most symmetrical at energy losses of about 50%. Their asymmetry increases noticeably towards large energy losses. The calculations are valid for initial energies up to about 30% of the particle rest energy. The lower energy limit is determined by the importance of the inner shell corrections to the stopping power which have been neglected in this treatment. Within these energy limits the results apply to any absorber element throughout the periodic system. (auth)

46129 GENERATION OF A FAST ARGON ATOMIC BEAM WITH A PLASMA SOURCE. Kessler, R. W.; Koglin, B. (Kernforschungszentrum, Karlsruhe, Ger. Technische Hochschule, Karlsruhe, Ger.). Z. Angew. Phys., 23: 316-19(Oct. 1967). (In German).

The core of a hot argon supersonic beam, produced by a dc arc source, is transferred to high vacuum by differential pumping. The kinetic energy and the Mach number of the resulting fast atomic beam is measured by a time-of-flight setup, the intensity by a Pitot tube in combination with a diaphragm manometer. The maximum kinetic energy attained is 5.5 eV at a Mach number of 7. The maximum atomic beam intensity is $1.2 \cdot 10^{18}$ atoms/cm^{2}sec at a distance of 54 mm from the last beam collimating orifice. (auth)

46130 SYSTEMATIC STUDY OF THE BROADENING OF MAGNETIC DEPOLARIZATION CURVES BY HOLTSMARK COLLISIONS BETWEEN DIFFERENT ISOTOPES OF Hg. Omont, Alain (CNRS, Paris). Compt. Rend., Ser. A and B, 265: 31-4 (July 3, 1967). (In French).

The relaxation of the alignment and of the orientation of the 6^3P_1 level of some Hg isotopes by resonant collisions around atoms of other isotopes was measured by applying the method of Meunier et al. All the results were in good agreement with theory. (tr-auth)

46131 COMPARED EFFECTS OF H_2 AND D_2 ON THE POSITION AND THE SPECTRAL PROFILE OF THE LINE $\lambda = 2{,}537$ A OF ^{198}Hg. Butaux, Jean; Lennuier, Robert (Laboratoire des Recherches Physiques, Paris). Compt. Rend., Ser. A and B, 265: 43-4(July 3, 1967). (In French).

Measurements were made for perturbating gas pressures lower than 1 atm. The collision cross sections ($Hg^* - H_2$) and ($Hg^* - D_2$) are almost equal. But the displacement of the center of the line and the ratios of the broadening to the displacement are very different. (tr-auth)

46132 NEW FORMULATION OF THE THEORY OF ELECTRONIC STRUCTURE. Kohn, W. (Univ. of California, San Diego, La Jolla). pp 13-23 of Proceedings of the 1966 Midwest Conference on Theoretical Physics, Indiana University, May 20-21, 1966. Lichtenberg, D. B. (ed.). Bloomington, Ind., Indiana University, 1966.

See CONF-660545.

In the formulation of the theory of electronic structure the basic variable is the electronic density, and the energies and other thermodynamic properties of all electronic systems, finite or infinite, are formally expressed in a single universal functional of the density. All many-body effects are in principle exactly incorporated in this functional, and the theory is fully quantum mechanical. Yet because of the central role of the density it is similar in many ways to a classical fluid. (J.F.P.)

46133 HIGH INTENSITY NOZZLE BEAM SOURCE FOR USE IN MOLECULAR TOTAL CROSS SECTION MEASUREMENTS. Skofronick, J. G. (Florida State Univ., Tallahassee). Rev. Sci. Instrum., 38: 1628-31(Nov. 1967).

A nozzle source which produces beams of neutral molecules, a factor of 10^2 to 10^3 more intense than that from effusive sources, is described. Further, the velocity distribution from this source is much narrower than that from effusive sources. The properties of the source and a description of its use in total cross section measurements for the case of a He beam on a H_2 scatterer are presented. (auth)

46134 ATOM-ATOM COLLISION PROCESSES IN ASTROPHYSICS: THEORETICAL STUDIES. Dalgarno, A. (Queen's Univ., Belfast). Rev. Mod. Phys., 39: 850-7(Oct. 1967).

Theoretical studies of atom-atom collision processes that may be relevant to the interpretation of astrophysical phenomena are reviewed. Work on excitation, ionization, and electron capture in atomic hydrogen by fast protons and He^+ ions is summarized. Processes involving slow collisions that are listed include radiative charge transfer and association, associative detachment, Penning ionization, spin-change, collision-induced deactivation, mutual neutralization, and rotational excitation. (auth)

46135 SOME PROBLEMS IN PLANETARY ATMOSPHERES INVOLVING COLLISION PROCESSES. Dalgarno, A. (Queen's Univ., Belfast). Rev. Mod. Phys., 39: 858-61(Oct. 1967).

A brief selection of problems occurring in the interpretation of planetary atmospheres, the resolution of which demands a knowledge of atomic collision processes, is presented. The selection is largely arbitrary. (auth)

46136 MODERATELY LONG-RANGE INTERATOMIC FORCES. Chang, Tai Yup (Univ. of Wisconsin, Madison). Rev. Mod. Phys., 39: 911-42(Oct. 1967).

The moderately long-range interaction energies of degenerate atoms for nonresonant cases have been studied throughout the moderately long-range region. Extensive tabulation of necessary parameters and atomic properties for the calculation of the first-order quadrupole-quadrupole interaction energies has been made. Higher multipole interactions also have been considered and it has been shown that the $1/R$ series of the first-order Coulombic interaction energies converges very fast throughout the long-range region for atoms in the ground configuration. The effects of atomic spin-orbit splitting have been considered explicitly. It has been shown that (A, S) coupling and intermediate coupling may be important for the interactions between B, C, O, Al, Si, and Sc atoms in the relatively short internuclear separation range. For other atoms, the (J_a, J_b) coupling scheme will give satisfactory results throughout the long-range region. The experimental determination of the moderately long-range interatomic forces from predissociation data also has been discussed. The estimated van der Waals dispersion energies for the first-row atoms are shown to be of almost the same size as the quadrupole-quadrupole interaction energies at the separation of twice the sum of the atomic radii. It has been also shown that the leading term $[O(\alpha^2/R^3)]$ of the magnetic interaction energy of two degenerate atoms is 10 to 20% of the quadrupole-quadrupole interaction energy at $R = 30a_0$ through the third-row atoms. (auth)

46137 PENETRATION OF HYDROGEN IONS INTO COPPER. Zarutskii, E. M. (Leningrad Polytechnic Inst.). Sov. Phys.-Solid State (Engl. Transl.), 9: 1172-5(Nov. 1967).

Translated from Fiz. Tverd. Tela, 9: 1500-4(May 1967).

The penetration of hydrogen ions having energies up to 20 keV into copper was investigated by bombarding free films with them. The energy spectra of the emergent ions were analyzed with a mass analyzer, and the positions of the distribution peaks on the energy scale were interpreted. The free-path-energy curves and the energy spectra of the ions passing through thin films attest that the specific energy losses are proportional to the velocities of the incident ions, and retardation occurs mainly by electrons in the crystal structure. It was shown that molecular hydrogen ions are completely dissociated upon striking the surface of the metal film. (auth)

46138 DISCRETE ABSORPTION BY 4d ELECTRONS IN THE LANTHANUM-GROUP RARE-EARTH METALS. Fomichev, V. A.; Zimkina, T. M.; Gribovskii, S. A.; Zhukova, I. I. (Leningrad State Univ.). Sov. Phys.-Solid State (Engl. Transl.), 9: 1163-5(Nov. 1967).

Translated from Fiz. Tverd. Tela, 9: 1490-2(May 1967).

The fine structure in the absorption spectra of 12 lanthanum group rare earth metals was studied in the energy region near the $N_{IV,V}$ absorption edge. It is suggested that narrow selective absorption lines arise as a result of the transition of 4d electrons to free localized states in the 4f shell. (auth)

46139 ANOMALIES IN THE CHARACTER OF THE X-RAY ABSORPTION OF RARE-EARTH ELEMENTS OF THE LANTHANIDE GROUP. Zimkina, T. M.; Fomichev, V. A.; Gribovskii, S. A.; Zhukova, I. I. (Leningrad State Univ.). Sov. Phys.-Solid State (Engl. Transl.), 9: 1128-30(Nov. 1967).

Translated from Fiz. Tverd. Tela, 9: 1447-50(May 1967).

The absorption spectra of 13 rare earth metals of the lanthanide group were studied in the ultrasoft x-ray region (25 to 250 Å). Strong maxima due to photoionization of the 4d electrons were found. There is a substantial change in the structure of the spectra with increasing atomic number. (auth)

46140 POSITRONIUM ATOM IN SOLIDS. Prokop'ev, E. P. (Scientific-Research Physical-Chemical Inst., Moscow). Sov. Phys.-Solid State (Engl. Transl.), 9: 993-4(Oct. 1967).

Translated from Fiz. Tverd. Tela, 9: 1266-8(Apr. 1967).

The properties of positronium in various solids and of the criteria that determine its dynamic stability are considered. Thermalized positronium is regarded as a special impurity atom (a point defect) in a solid, and the problem is reduced to a study of the influence of defects of this type on the electron energy spectrum of the solid. The solution of the problem is obtained by determination of the one-fermion Green's function $G_c(x, x')$ in the presence of a field produced by a positron. It is also shown that information on the screening parameter can be obtained from experimental data on the relative rate of three-gamma coincidence and from measurements of the lifetimes. (A.G.W.)

46141 ABSOLUTE DETERMINATIONS OF TOTAL AND PARTIAL EFFECTIVE IONIZATION CROSS SECTIONS OF HELIUM, NEON, ARGON, AND ACETYLENE FOR ELECTRONS OF 100 TO 2000 eV. Gaudin, Albert; Hagemann, Robert (CEN, Saclay, Gif-sur-Yvette, France). J. Chim. Phys., 64: 1209-21 (July-Aug. 1967). (In French).

The total electronic impact ionization cross sections have been measured for He, Ne, Ar, and C_2H_2 in the range of energy between

100 and 2000 eV. The partial cross sections have been determined by mass spectrometry in the same range of energy. The studied ions are He^+ and He^{2+}, Ne^+ up to Ne^{4+}, Ar^+ up to Ar^{5+} and CeH_2^+, C_2H^+, CH^+, C^+, $C_2H_2^{2+}$, and C_2H^{2+} from C_2H_2. The accuracy on the absolute ionization cross sections values was estimated between 10 and 15%. The results are presented according to the Born-Bethe approximation. The validity ranges of the laws $\sigma E = A \text{ Log } BE$ and $\sigma E = cte$ are described. (auth)

46142 STUDY OF THE HYPERFINE STRUCTURES OF THE 6^1P_1 LEVELS OF THE ISOTOPES ^{199}Hg AND ^{201}Hg BY THE LEVEL CROSSING METHOD. Lecler, Daniel; Margerie, Jean (Faculte des Sciences, Caen, France). Compt. Rend., Ser. A and B, 265: 123-6(July 10, 1967). (In French).

The ratios A/g_J of the magnetic dipole coupling constant to the Landé factor were measured for the 6^1P_1 levels of the isotopes ^{199}Hg and ^{201}Hg using the level-crossing technique. (tr-auth)

46143 SOME CONSEQUENCES OF THE MAGNETIC INTERACTION OF PROTONS AND ELECTRONS. Dixon, W. T. (Bedford Coll., London). Theor. Chim. Acta, 6: 359-61(1966).

The magnetic moment of a nucleus interacts with nearby electrons in a molecule in such a way that they are to a small extent unpaired; that is, the 2 possible spin wave functions of an electron acquire different weights in different parts of the molecule. This is seen most clearly in the simplest case, the hydrogen molecule $H_a - H_b$ (or rather, hydrogen deuteride). The magnetic effect of nucleus H_a leads to a mixing of singlet and triplet states and the lowest of these is the most important in forming a ground-state wave function which includes the perturbation. An equation was derived relating this wave function to the spatial atomic orbitals of H_a and H_b and the electron spin eigenfunctions. This equation shows that the opposite spin would be associated with the other atomic orbital which goes into the formation of the bond. If H_b is replaced by a hydrocarbon radical fragment R, so that the molecule becomes $R - H_a$, the $C - H_a$ bond would be approximately isolated from the rest of the molecule. The coupling constants between H_a and the other nuclei should be approximately proportional to the spin densities at those nuclei in the radical R_-. A simple proportionality should obtain between the coupling constants in the radical and corresponding proton-proton interactions in the molecule as measured by NMR, and such a relation does appear to exist experimentally, to a certain extent. Experimental results for olefinic compounds and radicals give some confidence in a method for working out proton spin-spin coupling constants in hydrocarbons, i.e., they will be proportional to the spin densities at the nuclei in the appropriate hypothetical radical fragment. (BBB)

46144 LOCAL ENERGY EXAMINATION OF ACCURATE VARIATIONAL GAUSSIAN WAVEFUNCTIONS FOR THE H-ATOM GROUND STATE. Schwartz, Maurice E. (Mathematical Inst., Oxford. Princeton Univ., N. J.). Chem. Phys. Lett., 1: 269-71(Sept. 1967).

In order to understand more fully some recent lower-bound computations for Gaussian expansions of the H-atom ground state, a study of the local energy for these wave functions has been made. It is found that the local kinetic energy $T\varphi/\varphi$ (T = kinetic energy operator; φ = wavefunction) is quite poor near the nucleus, and it is shown how this gives poor accuracy for the energy variance $\langle \mathcal{H} \rangle^2 - \langle \mathcal{H} \rangle^2$ and hence for lower bounds. (auth)

46145 YIELD OF EXCITED ATOMS IN A BEAM FORMED BY CHARGE EXCHANGE IN A PARTIALLY IONIZED GAS TARGET. Berkner, K. H.; King, I. I.; Riviere, A. C. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Nucl. Fusion, 7: 115-21(Sept. 1967).

Beams of excited hydrogen atoms are commonly produced for neutral injection experiments by charge exchange in a gas target. The passage of the beam through the target also ionizes the gas and the amount of ionization will increase as beam intensities are increased. Measurements have been made of the effect of ionization of the gas in a charge exchange cell on the yield of excited atoms. The results are compared with calculations of the effect based on the best available experimental, theoretical, or estimated collision cross-section values in that order of preference. The agreement between calculation and experiment is considered to be satisfactory and the method of calculation is used to predict the effect at higher ion densities in the cell. It is found that the population of a given excited level falls to a very small value when the ion density is greater than a critical value. (auth)

46146 RADIATION EFFECTS IN EXPERIMENTS ON OPPOSITE ELECTRON BEAMS. Baier, V. N.; Fadin, V. S.; Khoze, V. A. (Novosibirsk State Univ., USSR). Dokl. Akad. Nauk SSSR, 174: 323-6(May 11, 1967). (In Russian).

Simple expressions are formed for profiles of the process of electron scattering by photon radiation with random energy into narrow cones along the direction of particle motion. Based on these expressions, general equations are derived for radiation corrections to the profile of electron-to-electron scattering. The radiation cross section of soft photons, in the case of arbitrary electron scattering angles, is calculated. (ATD)

46147 POLARIZATION AND RELAXATION OF PROTONS IN IRRADIATED LANTHANUM MAGNESIUM NITRATE. Butterworth, J.; Orchard-Webb, J.; Riley, J.; Wigan, M. R. (Atomic Energy Research Establishment, Harwell, Eng.). Proc. Phys. Soc. (London), 91: 605-11(July 1967).

Measurements were made of proton polarization, proton relaxation, and the shape, intensity and spin–lattice relaxation rate of an electron spin resonance line from damage centers in a lanthanum magnesium nitrate target during a bombardment with 146-MeV protons. The damage centers exhibited an inhomogeneously broadened line centered on a g value of 2.002 ± 0.002, and their energy of formation was found to be 1.0 ± 0.4 eV. At 9.5 Gc spin–lattice relaxation rates of $(7 \pm 3) \times 10^2$ sec^{-1} and $(5 \pm 2) \times 10^2$ sec^{-1} were measured at temperatures of 4.2 and 1.4°K, respectively. On the assumption that these centers are the sole cause of the observed decay in polarization, it is deduced that about half of the decay may be attributed to relaxation of the protons. The remainder of the decay may be attributed to detuning of protons, providing each damage center occludes an average of about 700 protons. From the relaxation data an order-of-magnitude value for the damage-center spin fluctuation rate of 10^5 sec^{-1} at 35.2 Gc/s was derived. This value is used in a comparison of the observed damage-center contribution to proton relaxation with that predicted by different theoretical models. The hindered-diffusion model of Khutsishvili, [Soviet Physics-JETP, 15:909-13 (1962)], fits the observations to within a factor of 2. His value for the diffusion barrier radius is found to be the same as the radius of occlusion derived from the decay in polarization, namely 16 Å. The shell-of-influence model of Schmugge and Jeffries leads to a relaxation rate that is faster than observed by a factor of 50. Unhindered diffusion, an analysed by de Gennes [J. Phys. Chem. Solids, 7: 345-50(1958)], is too efficient by a factor of about 400 to fit the observations. (auth) (UK)

46148 BINDING ENERGY OF Cs ATOMS ADSORBED ON (110) AND (100) FACES OF A TUNGSTEN CRYSTAL. Gavrilyuk, V. M.; Vedula, Yu. S.; Naumovets, A. G.; Fedorus, A. G. (Inst. of Physics, Kiev). Sov. Phys.-Solid State (Engl. Transl.), 9: 881-3(Oct. 1967).

Translated from Fiz. Tverd. Tela, 9: 1126-28(Apr. 1967).

The isobars of the adsorption of cesium on the (110) and (100) faces of a tungsten crystal were measured. From the isobars the dependence of the heat of adsorption q on the surface density of cesium atoms n was calculated. At low values of n the heats of adsorption were $q_{110} = 3.2$ eV and $q_{100} = 2.8$ eV; when n increased up to $\approx 5 \times 10^{14}$ atoms/cm^2, these values decreased to the heat of sublimation of cesium (0.8 eV). (auth)

46149 RECIPROCAL ACTION OF ELECTRONS ON MATTER. Boersch, H. (Technische Univ., Berlin). Mikroskopie, 21: 122-41(Mar. 1967). (In German).

Scattering of electrons in materials at liquid-He temperatures was studied using a superconducting magnetic lens system. A dynamic theory for complex atomic scattering amplitudes was developed on the basis of electron optical studies. Development of a low-temperature arrangement (down to 2.8°K) for electron diffraction, microscopy, and β-energy loss spectroscopy is described, as well as application of the dynamic theory to the anomalous increase of transparency of low-temperature crystals. Measurements were made with a newly constructed electron energy analyzer of high resolution (0.0045 eV of 30,000-eV electrons). Energy losses were studied in gases by pure electron transitions (dipole, quadrupole) by vibrational and rotational transitions and fundamental vibrations. Determinations were made of oscillator strengths and Franck–Condon factors by energy loss spectra. Energy losses in thin layers were studied by band–band transitions, by creation of volume and surface plasmons, excitons, and phonons, and energy gains by annihilation of phonons. Energy losses from elastic scattering in crystals in the case of large angle scattering were also examined. (BBB)

46150 ELECTRON-OPTICAL PARAMETERS OF TWO-ELECTRODE CYLINDRICAL IMMERSION LENSES. Glikman, L. G.; Kel'man, V. M.; Yakushev, E. M. (Inst. of Nuclear Physics, Alma Ata, USSR). Zh. Tekh. Fiz., 37: 1028-34(June 1967). (In Russian).

With the aid of a computer, the authors have calculated the focal lengths and the positions of the principal foci of two-electrode electrostatic lenses of which one electrode is a pair of half-planes with the equations $2y = \pm d_1$, $z < s$, and the other electrode is a

pair of half-planes with the equations $2y = \pm d_2$, $z > 0$ (x,y, and z are rectangular Cartesian coordinates). The case when $d_1 = d_2$ and $s = 0$ is treated in the monograph of J. R. Pierce on the theory and calculation of electron beams. An analytic expression for the potential within the lens is derived for arbitrary values of d_1, d_2, and s by means of a Schwarz–Christoffel transformation. The nonrelativistic equations for a paraxial trajectory were solved with the computer for a number of different values of d_1/d_2, s/d_1 (s was taken as zero except in the case when $d_1 = d_2$), and V_1/V_2, where V_1 and V_2 are the potentials on the two electrodes, the potential being taken as zero at the point where the velocity of the particle vanishes and the resulting values of the focal lengths and the positions of the foci are tabulated. The tabulated data can be adapted by a simple transformation to the case of trajectories making large angles with the x–y plane, but not, of course, for trajectories making large angles with the x–z plane. It was found that for the case when $d_1 = d_2 = d$, the solution for $s = 0$ is a good approximation to the solutions for values of s between $-d/4$ and 0. (ATD)

46151 OPTIMUM MAGNIFICATION OF THE ELECTROSTATIC FOCUSING SYSTEM FOR DIFFERENT METHODS OF DEFLECTING THE ELECTRON BEAM. Gershberg, A. E.; Kuz'minova, Z. I. Zh. Tekh. Fiz., 37: 1035-44(June 1967). (In Russian).

The defocusing action of electron beam deflecting systems of three types is discussed: those employing a uniform electric field (deflector plates); those employing a uniform magnetic field; and those of the deflectron type. The increase of the diameter of the image of the electron source on the screen of an instrument such as a vidicon due to the defocusing action of the deflecting system is the greater, the lower the magnification of the focusing system; on the other hand, the diameter of the undistorted image is the greater, the higher the magnification. There is therefore an optimum magnification that gives the highest resolving power for a given deflection system. This optimum magnification was calculated for the three investigated types of deflecting system, and numerical results are presented both graphically and in tabular form for different values of the parameters, including parameter values typical of electrostatic vidicons. Thin-lens formulas (Gaussian optics) were employed in the calculations. If the aberrations are independent of the magnification, their presence does not alter the optimum magnification, although it reduces the maximum resolving power. For conditions typical of electrostatic vidicons, the optimum magnification is 2.5 to 3.5 for uniform electrostatic field deflection (deflector plates), 1.5 to 2.5 for deflectron deflection, and about 1.5 for uniform magnetic field deflection. (ATD)

46152 DESORPTION OF IONS FROM THE SURFACE OF A COPPER LAYER BY SLOW ELECTRONS. Datsiev, M. I.; Ionov, N. I. (Leningrad State Univ.). Zh. Tekh. Fiz., 37: 1140-7(June 1967). (In Russian).

A MS MKh-1303 mass spectrometer was adjusted for investigating the desorption of ions by slow electrons from the surface of metallic adsorbents. The experimental results of O^+ ion desorption from copper targets are in qualitative agreement with the established data on desorption from other metals. The state of absorption of CO molecules confirming the experimental results on thermal desorption (flash method) was observed. The relation of the relative probability of desorption of ions by slow electrons was measured. This relation passes through the maximum at an electron energy of about 75 eV and has an energy threshold equal to 17.4 ± 0.4 eV. Desorption by electrons of atomic ions of halides and alkali metals which diffuse on the target surface from a lattice was observed. The possibility is shown of determining the kinetic characteristics of diffusion of impurities on the surface. (ATD)

46153 EXCITATION OF SURFACE WAVES BY A MOVING CHARGE. Pafomov, V. E.; Fetisov, E. P. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz., 53: 965-77(Sept. 1967). (In Russian).

The field of surface waves excited by an arbitrarily moving charged particle on the interface between vacuum and an absorbing nonmagnetic medium is calculated. Excitation of surface waves by a particle moving uniformly and rectilinearly at an angle with respect to the interface is considered. The particular cases of normal incidence and of motion of the charge parallel to the interface are also considered. For glancing incidence the surface wave excitation spectral energy density exceeds the transition radiation intensity by several orders of magnitude. The estimates presented show that the intense radiation observed experimentally which is produced by electrons impinging on a silver target at grazing angles may be explained by scattering of the surface wave on irregularities of the surface. (auth)

46154 TEMPERATURE DEPENDENCE OF POSITRON MEAN LIVES IN METALS. MacKenzie, I. K.; Khoo, T. L.; McDonald, A. B.; McKee, B. T. A. (Dalhousie Univ., Halifax, Nova Scotia). Phys. Rev. Lett., 19: 946-63(Oct. 23, 1967).

The dependence of positron lifetimes on sample temperature has been studied in several metals over a range from room temperature to the melting point or to 400°C. Marked effects, amounting to as much as a 30% increase in lifetime, are noted in most of the low-melting-point metals. Lattice vacancies are considered to be the likely cause of these effects. (auth)

46155 EXPERIMENTAL CROSS SECTIONS OF RADIATIVE RECOMBINATION OF ELECTRONS ON THE 6P AND 5D LEVELS OF CESIUM. Gridneva, S. M.; Kasabov, G. A. (Inst. of Atomic Energy, Moscow). Teplofiz. Vys. Temp., 5: 373-4(Mar.-Apr. 1967). (In Russian).

Results of various measurements of the absolute cesium luminescence intensities were analyzed, and experimental cross sections for radiative electron recombinations on the 6P and 5D levels were found to be $\sigma_{6P} = 8.8 \times 10^{-22}\ \epsilon^{-1}\ cm^3$ and $\sigma_{5D} = 2.1 \times 10^{-21}\ \epsilon^{-1}\ cm^3$ (ϵ is energy of electron recombination in eV). (R.V.J.)

46156 STATISTICAL THEORY OF ION–MOLECULE CHEMICAL REACTIONS. Mordvinov, Yu. P.; Smirnov, B. M. (Inst. of Atomic Energy, Moscow). Teplofiz. Vys. Temp., 5: 219-23(Mar.-Apr. 1967). (In Russian).

The cross sections of ion–molecule chemical reactions expressed by the characteristics of the possible finite products were computed. It was assumed that polarized capture resulted in a complex of particles which were retained until they reached a complete mixing state. Moreover, the probability of the system transition into the given state is proportional to the statistical weight of the state and to the rate of particle scattering. Assuming the presence of a centrifugal barrier and applying the laws of total conservation of energy and angular momentum, the reactions considered are: $H_2^+ + He \rightarrow HeH^+ + H$ and $D_2^+ + He \rightarrow HeD^+ + D$. The statistical theory was used for finding the mobility of ions in molecular gases. The ratio between ion mobility and ion and molecular mass was used to reveal the type of ions formed in a given gas. (tr-auth)

46157 MEASUREMENT OF ACCOMMODATION COEFFICIENTS OF VERY HIGH ENERGY MOLECULES. Devienne, F. Marcel (Laboratorie Mediterraneen de Recherches Thermodynamiques, Nice). Int. J. Heat Mass Transfer, 10: 1109-19(Aug. 1967). (In French).

The different phenomena that may be produced by the impact of a high energy molecule on a metallic surface are discussed. The measurement methods used to determine the accommodation coefficient are described. Different physical parameters influence the values of accommodation coefficients, for instance, outgassing, whose influence is, however, less important for high energy molecules than for thermal energy molecules. The accommodation coefficients generally increase in relation to the energy, and decrease when the incidence angle increases. They depend on the nature of the molecules and, for the same gas, on their atomicity. The accommodation coefficients also vary with the nature of the surface. Research has been done in the case of helium, argon, hydrogen, and nitrogen with metallic surfaces of aluminum, silver, gold, and platinum. The range of energy is between 500 and 12,000 eV. (auth)

46158 RESONANT STATES OF H_2^-. Eliezer, I.; Taylor, H. S.; Williams, James K. Jr. (Univ. of Southern California, Los Angeles). Contract GP-4284. J. Chem. Phys., 47: 2165-77 (Sept. 15, 1967).

Detailed quantitative calculations are reported for different resonant states of H_2^-. Results tie in quantitatively with dissociative attachment experiments and electron-scattering experiments, and qualitatively with vibrational-excitation experiments. Preliminary results on other states not as yet experimentally observed are also discussed. Wave functions and energies are reported. (auth)

46159 KINETICS OF THE TWO-BODY RADIATIVE ASSOCIATION OF ATOMS. Palmer, Howard B. (Pennsylvania State Univ., University Park). J. Chem. Phys., 47: 2116-20(Sept. 15, 1967).

A treatment of radiative association of atoms based on equilibrium statistical mechanics is presented for the case where colliding atoms enter the repulsive region of an excited state and radiatively stabilize by undergoing electronic transition to the ground state. The final rate expression is the same as that derived from scattering theory when the potential is pure repulsive. The equilibrium treatment seems to have some advantages, for this special interaction, and may actually be somewhat more general than at first appears to be the case. (auth)

46160 ELECTRON SCATTERING BY ATOMIC HYDROGEN IN OCHKUR APPROXIMATION. Jha, R. (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys., 41: 373-7(May 1967).

The elastic (1s−1s) and inelastic (1s−2s, 1s−2P) scattering of electrons by atomic hydrogen was investigated in Ochkur approximation and the overall agreement with experiment obtained is better than the usual first Born approximation. (auth)

46161 EFFECT OF HIGHER ORDER PARTIAL WAVE PHASE-SHIFTS IN ELASTIC ELECTRON SCATTERING BY HELIUM ATOM. Banerjee, S. N.; Sil, N. C. (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys., 41: 358-61(May 1967).

In elastic e^- He scattering in the energy range of 13.6 to 54.4 eV the higher order phase shifts ($l > 3$) were calculated in the Born approximation; making use of lower-order phase shifts (i.e., for $l = 0, 1, 2$) from the calculation of LaBahn and Callaway (1966), it was found that the inclusion of the higher-order phase shifts considerably improves the value of the total and differential cross sections in bringing them to better agreement with the experimental results. (auth)

46162 STRETCHING AND THE DIFFERENCE IN THE INTERMOLECULAR POTENTIALS OF H_2 AND D_2 FROM LOW TEMPERATURE DATA. Ghosh, A. K.; Barua, A. K. (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys., 41: 341-6(May 1967).

By analyzing the low-temperature viscosity data of H_2 and D_2 the effect of stretching on the intermolecular potentials of H_2 and D_2 was considered. In the calculations quantum effects were also taken into account. The results confirm the suggestion by Barua and Saran regarding the temperature dependence of the difference in the intermolecular potentials of H_2 and D_2. (auth)

46163 ELECTRON IMPACT OF HYDROGENIC BOUND ELECTRON. Das, J. N. (Calcutta Univ.). Indian J. Phys., 41: 332-5(May 1967).

The cross section for the excitation of a hydrogenic bound electron by electron impact was calculated in a field theoretic way. For low impact energy this reduces to the usual Born approximation result. At higher energies the result is a relativistic generalization. Better approximations for Bethe's approximate formulae for the high-energy excitation cross section are also obtained. (auth)

46164 K-, L-, AND M-SHELL ATOMIC PHOTOEFFECT FOR SCREENED POTENTIAL MODELS. Schmickley, Ronald Dean. Stanford, Calif., Stanford Univ., 1967. 409p.

Thesis.

The K-, L-, and M-shell atomic photoeffect total cross sections, differential cross sections, and polarization correlations were numerically calculated for various central potential models of the atom. Calculations to investigate screening effects were made for Thomas−Fermi, Kerner, and Yukawa potentials, and these were compared with Coulomb results. The calculations were made mainly for Z = 26, 50, and 92 and for incident photon energies of 412, 662, and 1332 keV. It was found that, within the present computational errors, the effects of screening on the absolute cross sections could be accounted for by a screening factor equal to the square of the ratio of the bound-state screened to unscreened normalizations. This normalization effect was examined in more detail by studying the individual radial matrix elements of the partial wave expansion of the total matrix element. The theoretical explanation of the normalization effect, first suggested by R. H. Pratt, was generally substantiated by this investigation. This effect was used to predict realistic total cross sections, which compare favorably with experiment. Angular distribution shapes and polarization correlations were found to be independent of screening, in agreement with the normalization effect theory. A few illustrative figures and several numerical tabulations are given for the total cross sections, angular distributions, and polarization correlations. (Disser. Abstr.)

46165 ELECTRON ENERGY DISTRIBUTIONS FROM IONIZING COLLISIONS OF HELIUM AND NEON IONS WITH HELIUM. Barker, Robert Bramley. Syracuse, N. Y., Syracuse Univ., 1966. 95p.

Thesis.

The electron energy distributions arising from ionizing collisions of He ions with a He target and Ne ions with a He target have been examined. Incident ions were in the energy range 1 to 4 keV. The distributions consisted of a sharp maximum near the zero of self energy with broader peaks occurring in the 20- to 40-eV region. Two broad peaks are detectable in the He^+−He energy spectrum and six peaks are found in the Ne^+−He spectrum. The energy of the maxima of the prominent broader peaks have been shown to fit a linear dependence upon inverse ion velocity over all or part of the energy range investigated. This dependence, when extrapolated to infinite ion energy, has yielded peak energies that correspond to previously identified autoionizing states. For He^+−He, the single prominent peak corresponds to $He(2s)(2p)\ ^1P$; for Ne^+−He, the two prominent peaks correspond to $Ne(2s)(2p)^6(3s)\ ^1S$ and to a state whose electronic configuration is unknown. By assuming the same dependence upon ion velocity for less prominent peaks, the single additional He^+−He peak and two Ne^+−He peaks are shown to correspond approximately to known autoionizing states. Two additional peaks from the Ne^+−He distribution appear to be due to previously unreported Ne autoionizing states. Where measurement is possible, these same peaks have exhibited a peak width that sharpens linearly with inverse ion velocity. A model is presented, which attributes the observed behavior to the collision-induced excitation of autoionizing states followed by autoionization transitions in the field of the ion, the ion causing a displacement of isolated atom energy states. (Disser. Abstr.)

46166 NEGATIVE ION CHARGE TRANSFER WITH ATOMIC TARGETS. Snow, William Rosebrook. Seattle, Univ. of Washington, 1966. 102p.

Thesis.

Relative cross sections for the negative-ion charge-transfer reactions $H^- + O$, $O^- + O$, $O^- + H$, $C^- + O$, and $C^- + H$ have been measured over the energy range of 0.5 to 4 keV using a modulated atomic beam technique. Absolute magnitudes of the cross sections were obtained by normalization to the experimental measurement of $H^- + H$ by Hummer, Stebbings, Fite, and Branscomb (1960). Partially dissociated beams of oxygen and hydrogen were produced by a microwave discharge. The neutral beam was partially ionized by electron bombardment and the fraction of atoms in the beam measured through the use of a 180° mass spectrometer. The slow negative ions resulting from charge transfer were mass analyzed to provide positive identification of the process involved. The resonant reaction, $O^- + O$, is found to be in reasonable agreement with the approximate theory of Firsov (1951). The nonresonant reactions $H^- + O$, $O^- + H$, $C^- + O$, and $C^- + H$ are in good qualitative agreement with the predictions of Rapp and Francis (1962), and detailed balancing is found to hold for $H^- + O \rightleftharpoons H + O^-$. Suitable correction for polarization forces in the nonresonant reactions improves the agreement of the experimental energies of maximum cross section with those predicted by the adiabatic criterion. It appears that negative-ion charge transfer in this intermediate energy range is very similar to positive-ion charge transfer. (Disser. Abstr.)

46167 ON THE THEORY OF ELECTRON CAPTURE IN $He + H^+$ COLLISIONS. Chang, Loh-yi. Stillwater, Okla., Oklahoma State Univ., 1966. 46p.

Thesis.

The theory of atomic collisions at kilovolt energies is developed. By assuming strong coupling among certain electronic configurations of the colliding atoms, the theory is applied to the $He + H^+$ electron capture process. Calculations of electron capture resonance peaks and antipeaks were compared with the experimental data of Ziemba, et al. The close agreement between the observed and the calculated electron capture resonance peaks and antipeaks reflects the validity of the theory and the seemingly oversimplified assumptions. To account for the exact shape of the electron capture probability vs collision energy curve, the theory has to be further modified by the effects of center-of-mass correction as well as partial coupling. (Disser. Abstr.)

46168 ONE- AND TWO-DIMENSIONAL STEADY-STATE LOW-PRESSURE DISCHARGE THEORY. Shaw, Elden K. Stanford, Calif., Stanford Univ., 1967. 172p.

Thesis.

It is shown that a pressure theory approach, although approximate, when modified to take into account ion generation, can be used to accurately describe a wide variety of dc discharges in the low- and medium-pressure regimes. This modified pressure theory or fluid approach makes use of the "moment method" of solution of the Boltzmann equation to obtain differential equations which describe low-pressure discharges in terms of measurable macroscopic parameters. Solutions are found for the parameters of the discharges in one-dimensional planar, cylindrical, and coaxial geometries for various generation rates and including both the effects of ion−neutral collisions and an applied magnetic field. The results for the one-dimensional collisionless cases are compared with the more exact formulation of Langmuir and found to be in good agreement. In the limit of a small inner conductor, the one-dimensional coaxial solutions are shown to be useful in determining the properties of cylindrical Langmuir probes in the ion collection regime. The results are compared to present

collisionless probe theories and found to be in good agreement. The one-dimensional coaxial solutions are then extended to include the effects of collisions and an applied magnetic field on the characteristics of a cylindrical probe. For the most important case of ion generation proportional to electron density, two-dimensional solutions for the parameters of the discharges in a rectangular box, a finite length cylinder, and between finite length concentric coaxial cylinders are found for the first time. Calculated parameters for both the one- and two-dimensional discharges are presented graphically for a number of representative cases and the equations are tabulated and summarized in such a way as to be easily applied to other cases. The theory is also used to describe the behavior of two experimental devices: the so-called oscillating-electron ion source and the Kaufman ion source. Only qualitative agreement between experiment and theory is obtained when the two-dimensional theory is used to approximate the behavior of the oscillating-electron ion source. However, a one-dimensional theory which includes both primary or beam electrons and secondary or Maxwellian electrons is found to give good agreement between theory and experiment for the Kaufman ion source. (Disser. Abst.)

46169 POSITRON LIFETIMES IN LITHIUM–AMMONIA SOLUTIONS AND METHODS OF DATA ANALYSIS. Morales, Reynaldo. Austin, Tex., Univ. of Texas, 1967. 186p.

Thesis.

The lifetimes of positrons in lithium–ammonia solutions and in pure ammonia have been measured at a temperature of −65 C. The range of concentrations studied varied from 16.3 to 0.039 percent mole ratio of lithium to ammonia. The source of positrons was mixed in with the solutions and a correction was made for the annihilation of positrons in the glass walls of the sample cell. This correction was performed by subtracting from the measured data, a fraction of the lifetime spectrum of positrons annihilating in the glass walls of the sample cell with no solution present. After this correction was made, one mean life was found in the solutions with concentrations from 16.3% to 0.113%. Two mean lives were detected at a concentration of 0.078%, three mean lives at a concentration of 0.039% and two mean lives in pure ammonia. The data are interpreted in terms of one of the current models used in metal–ammonia work and in terms of a proposed model. Besides the method already mentioned for correcting for annihilations in the glass container, two other techniques are discussed. They correct a measured lifetime spectrum for an unwanted lifetime spectrum that may be intermixed with the desired lifetime spectrum. These techniques, which involve an improved use of the moment method of analyzing lifetimes, can be applied to lifetime spectra in general. It is well known that the results obtained by the moment method are sensitive to the range over which the integration is carried out when calculating the moments. The results are also sensitive to the uncertainty in the position of the centroid. It is shown that the results can be improved by a modification of the customary use of the moment method. This method corrects for finite cut-off of the lifetime data, in the case in which one or two lifetimes occur, and has been shown to work for a wide range of lifetimes and fractions of the long component. Furthermore, a technique is proposed that minimizes the troublesome problem of uncertainty in the centroid position. This is accomplished by an indirect determination of the best centroid position. (Disser. Abstr.)

46170 ANGULAR CORRELATION OF TWO-PHOTON POSITRON ANNIHILATION RADIATION IN LIQUID AND SOLID AMMONIA. Holt, William Henry. Austin, Tex., Univ. of Texas, 1967. 103p.

Thesis.

Angular distributions of two-photon annihilation radiation have been measured in liquid (−56°C) and solid (−84°C) ammonia. The apparatus was of the annular-slit type and the angular resolution widths were approximately two milliradians. The coincidence resolving time was 77×10^{-9} sec. A thin window in the all-glass sample container allowed positrons from an external ^{22}Na source to enter the ammonia samples. The data were corrected for accidental counts. Within the 2% statistical uncertainty of the data, the measured angular distributions were the same for both the liquid and solid samples. A linear average of the two distributions was taken to be the representative ammonia distribution. Geometrical resolution functions for the apparatus were calculated and an iterative procedure was used to correct the data for angular resolution. Assuming the density of momentum states to be spherically symmetric, the momentum distribution for the annihilating positron–electron pairs was determined from the corrected data. Since an admixture of 22% s- and 78% p-orbitals gives the observed ammonia HNH bond angles of 106°47′, an attempt was made to fit the high-momentum part of the experimental distribution with a distribution composed of 22% 2s and 78% 2p momentum distributions calculated for hydrogen-like atoms. The 2s,2p distribution did not have the necessary functional form; however, a distribution composed of 22% 3s and 78% 3p distributions gave a reasonably good fit at high-momentum. The difference in the 3s,3p distribution and the experimental distribution was attributed to the in-flight annihilation of positronium. The fraction of positrons that form positronium in ammonia as indicated by this analysis is in agreement with the fraction determined by mean-life measurements, if triplet positronium was converted to singlet positronium by spin exchange with the ammonia rather than by annihilation by pick-off. (Disser. Abstr.)

46171 MEASUREMENTS OF POSITRON LIFETIMES IN METALS. Weisberg, Howard Louis. Waltham, Mass., Brandeis Univ., 1965. 150p.

Thesis.

Measurements of positron lifetimes in various metals are reported. Strong evidence is given that the annihilation in pure metals is characterized by a single lifetime, the anomalous second lifetime reported by others being due to artifacts of sample preparation. The results obtained are accurate enough to permit comparisons with theoretical many-body calculations and they also shed some light on the significance of one-electron calculations of annihilation rate and angular correlation. The experimental techniques used are discussed in detail, and new electronic circuits for the time-to-pulse-height converter and the pile-up detector are presented. In addition, a theoretical calculation of the time dependence of positron annihilation in ferromagnets is presented, along with preliminary experimental work on this subject. (Disser. Abstr.)

46172 DETERMINATION OF THE ELECTRON SCATTERING CROSS SECTION IN A DENSE HYDROGEN PLASMA BY MEANS OF INTENSE LASER LIGHT. Merkelo, Henry. Urbana, Ill., Univ. of Illinois, 1966. 168p.

Thesis.

An investigation is presented which is aimed at arriving at the value of the fundamental cross section for the scattering of electromagnetic waves by free electrons. A review of the literature indicates that various measurements, especially in the x-ray region, approximate the theoretical value of the cross section, however, only under very restricted conditions. It is proposed that a fully dissociated, fully ionized hydrogen gas should provide a medium in which the cross section for the scattering of electromagnetic waves at optical frequencies should be that of free electrons. The theory for the scattering of electromagnetic waves by a plasma is reviewed in detail and conditions are defined for noncollective scattering. A scattering experiment is designed in conjunction with a high-power, ruby-laser, highly monochromatic light source and a high-density-plasma-producing apparatus. The plasma parameters derived from the spectroscopic analysis of the visible radiation emitted from the hydrogen plasma are compared with the plasma parameters obtained from the spectrally resolved scattered laser light and, with the aid of detector calibrations, limits on the cross section are established. (Disser. Abstr.)

46173 BAND STRUCTURE OF BERYLLIUM AND POSITRON ANNIHILATION IN METALS. Terrell, John Hart. Waltham, Mass., Brandeis Univ., 1965. 124p.

Thesis.

The measurement of the two-gamma angular distribution of annihilation radiation of positrons in metals shows up the band character of the electrons as well as many-body effects. The band character of the electrons for the specific case of beryllium is considered using the augmented plane wave method. The Fermi surface is found and comparison with a de Haas–van Alphen experiment is made. Good agreement is obtained. The dependence of the choice of electron and positron wave functions on the angular distribution of annihilation radiation is discussed. A calculation of the annihilation rate in a free electron gas is given by making a specific ansatz for the polarization cloud around the positron. A new basis set is constructed, which consists of a bound state wave function orthogonalized to a set of deformed plane waves. This calculation leads to good agreement with experiment although only the case of a fixed heavy impurity is discussed in detail. (Disser. Abstr.)

46174 A STUDY OF THE ELECTRON MOMENTUM DISTRIBUTION IN SILICON AND GERMANIUM BY POSITRON ANNIHILATION. Erskine, James Christian Jr. Cleveland, Western Reserve Univ., 1966. 71p.

Thesis.

The angular correlation of positron annihilation radiation from single crystals of silicon and germanium has been measured for three different orientations of each crystal. The distribution for the three orientations differ greatly from one another but each germanium distribution differs from the corresponding silicon

distribution only by a scale factor that arises from the difference in the lattice constant. Data are compared with curves calculated using the nearly free electron approximation for the electron's momentum. It is assumed that the occupied electron states in the crystal fill the Jones zone, a regular dodecahedron bounded by the set of 220 planes in momentum space, and the energy gap is taken to be an adjustable parameter. The fit is extremely good for the radiation emitted in the 110 plane but not so good for the 111 and 100 orientations. Possible reasons for the discrepancies are discussed. (Disser. Abstr.)

46175 IMPROVEMENTS IN OR RELATING TO ION SOURCES. Collins, Leslie Edward; Gobbett, Royston Henry (to United Kingdom Atomic Energy Authority). British Patent 1,086,914. Oct. 11, 1967. Filed Oct. 26, 1964.

Design information is presented on a duoplasmatron source for the production of negative ions. The compressor, anode, and extractor each having an orifice are designed so that negative ions from the outer region of an arc discharge established between the compressor and anode can be extracted from the discharge. (J.H.M.)

46176 DIFFERENTSIAL'NYE URAVNENIYA I IKH PRIMENENIE. (Differential Equations and Their Applications). Amandosov, A. A. (ed.). Alma-Ata, USSR, Izdatel'stvo Nauka Kazakhskoi SSR, 1967. 148p.

Nineteen articles are included on the use of differential equations in various problems; among those are: heat- and mass-exchange, electrodynamics, theory of elasticity, gas dynamics, optimum trajectories, and automatic control. The theory of infinite systems of differential and integro-differential equations and ordinary nonlinear differential equations containing small parameters are also discussed. An individual abstract was prepared for an article by Shalbaev on the relativistic electron in quantum mechanics. (R.V.J.)

46177 EMISSION SPECTRA OF THE MOLECULAR SYSTEM. Frackowiak, Mieczyslaw Florian. Torun, Poland, Copernicus Univ., 1965. (In Polish).

Thesis.

The energy of dissociation of the ground state of the nitrogen molecule was investigated. A highly detailed study of the $C\pi u - \beta^3\pi g$ spectrum system determined with the aid of a spectroscope with a very high resolving power is presented. (JPRS)

Cosmic Radiation

Refer also to abstracts 45458, 46113, 46457, and 46775.

46178 (N-67-18430) IMPROVED REENTRANT COSMIC RAY ALBEDO CALCULATION. Ray, Ernest C. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). [1965]. 19p. (NASA-TM-X-57252). CFSTI.

An earlier calculation of the intensity of reentrant albedo is repeated. An error in the previous calculation is corrected and the effects of nuclear interactions and the spiraling of trajectories are included. Improved fits to the altitude dependence of primary protons and to the Bethe-Block formula are used. The previously computed value of the reentrant albedo intensity was $j = 1.17$ $(m^2 sec\ sterad\ MeV)^{-1}$ or $j = 0.47(m^2 sec\ sterad\ MeV)^{-1}$, both at 85 MeV during December 1961 at Sioux Falls, South Dakota. The improved value obtained in the present paper is $j = 0.41(m^2 sec\ sterad\ MeV)^{-1}$ under the same conditions as for the previous calculations. Both calculations have omitted the contributions to the intensity of deuterons and tritons. (auth) (STAR)

46179 (N-67-18510) A NOTE ON THE GALACTIC RADIATION EXPOSURE IN GEOMAGNETICALLY UNPROTECTED REGIONS OF SPACE. Schaefer, Hermann J. (Naval School of Aviation Medicine, Pensacola, Fla.). Oct. 28, 1966. 19p. (NASA-CR-82018). CFSTI.

Measurements of the galactic flux at low rigidities during the Years of the Quiet Sun 1964-65 indicate that the galactic radiation is still modulated at solar minimum with the differential flux at low rigidities strongly depressed. Thus it is assumed that, in space systems of low shielding, no exceptionally large skin doses in a human target will result. This is quite different from that occurring from trapped radiation and solar particle beams. A conservative estimate for the total dose from galactic radiation at solar minimum including secondaries for 2π incidence is 50 millirads/24 hours with 5 to 8% of this dose produced by high LET components. If life shortening is used as criterion for long term effects, the quoted exposure corresponds to a factor of 0.2 in the sense that 100 days of exposure would shorten the residual life span by 20 days. (auth) (STAR)

46180 (N-67-18631) PROPAGATION OF COSMIC RAY NUCLEI IN INTERSTELLAR SPACE AND SOLAR SYSTEM. Durgaprasad, N. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Sept. 1966. 45p. (NASA-TM-X-55674). CFSTI.

The propagation of cosmic-ray nuclei in interstellar space and the solar system was studied with special reference to the recent data obtained on the various components of the cosmic radiation, using balloons, satellites and rockets. The following source spectra were assumed in the analysis: power law spectra in total energy per nucleon, and kinetic energy per nucleon and in rigidity. The constants and the exponents of these spectra were deduced from the high energy data that is little affected by solar modulation. The effective path length, x, in g/cm^2 traversed by the nuclei, was determined as a function of energy from a study of the variation of charge ratios of nuclei of charge $Z \geq 20$, $Z \geq 10$, $Z = 3$ to 5 and α particles. It was found that this path length traversed decreased with decreasing energy, consistent with a model $x = \beta c \rho t = \beta x_e$ where x_e is the high energy value of matter tranversed, βc is the velocity of the nucleus, ρ is the average density of matter and t is the age of the nuclei. Two mechanisms of modulation, the heliocentric electric field model and the generalized Parker's model, were used to study the temporal variations. It was found that the generalized Parker's model would explain the intensity variations over the period considered for all the components of the cosmic radiation using the source spectrum that is a power law in rigidity. The parameters involved in this model deduced for various years were found to be consistent with the values deduced by Parker from general dynamical theory of the solar wind and recent space observations. (auth) (STAR)

46181 (N-67-18751) OGO-E COSMIC RADIATION: NUCLEAR ABUNDANCE EXPERIMENT. Jones, S. L.; Ludwig, G. H.; Stilwell, D. E.; Trainor, J. H.; Way, S. H. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Nov. 1966. 25p. (NASA-TM-X-55692). CFSTI.

Information on the detailed charge and energy spectra of galactic and solar cosmic rays is required for a better understanding of the production, acceleration, and modulation of those cosmic rays. This experiment consists of a set of three detector assemblies to measure the differential energy spectra of protons and heavier nuclei through calcium (Z = 20) in the range of 400 keV to 1 BeV/nucleon. This includes an extensive electronics system to implement the logic, perform pulse-height analysis, measure particle fluxes, monitor experiment performance and interface with the OGO data system. (auth) (STAR)

46182 (N-67-18984) THE FLUX OF HEAVY NUCLEI IN THE PRIMARY COSMIC RAYS OVER TEXAS IN MARCH 1962, AND THE SOLAR CYCLE MODULATION. Biswas, S.; Kniffen, D. A.; Neelakantan, K. A. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Feb. 1967. 28p. (NASA-TM-X-55706). CFSTI.

The fluxes of heavy nuclei with $Z \geq 6$ in the primary cosmic radiation were measured with a nuclear emulsion stack exposed in a balloon flight, and the fluxes of $M(6 \leq Z \leq 9)$ and $H(Z \geq 10)$ nuclei extrapolated to the top of the atmosphere were found to be 6.20 ± 0.46 and 2.02 ± 0.25 particles m^2 ster sec, respectively. Results of this work and those of other investigations made during the last solar cycle (1954-1964) are used to study the long term solar modulation of primary S-nuclei ($Z \geq 6$) of rigidity ≥ 4.8 Bv. It is found that the lag between the primary intensity changes and the sunspot number is about one and a half years during the increasing phase of solar activity and is very small during the declining phase of solar activity. This is in agreement with the changes of the spectral shape during the solar cycle as suggested by Simpson. The implication of the time lag in terms of the scale size of the transition region of the magnetic field responsible for the long-term modulation is briefly discussed. (auth) (STAR)

46183 (N-67-23905) STUDY OF LOW-ENERGY GALACTIC COSMIC RAYS FROM 1961 TO 1965. Teegarden, Bonnard John (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Jan. 1967. 119p. (NASA-TM-X-55761; X-611-67-8). CFSTI.

Thesis. Submitted to Maryland Univ. [College Park].

The cosmic-ray intensity was measured on a balloon borne dE/dx and E detector sensitive to energies from 15 to 80 MeV/nucleon. Proton and helium intensities at 85 MeV/nucleon are given for the five year balloon flight period. The behavior of the proton to helium ratio as a time function is discussed within the framework of Parker's model for the solar modulation of cosmic rays. A cosmic-ray helium spectrum from 60 to 500 MeV/nucleon measured by a modified version of the detector is presented. The change in proton and helium intensities in

this energy range is examined and compared with results predicted by Parker's model. An empirical atmospheric secondary proton spectrum is derived based on simultaneous balloon and satellite measurements, compared with the secondary spectrum obtained from a nuclear emulsion measurement, and the differences discussed. Using this spectrum, an upper limit for the reentrant albedo at Sioux Falls is obtained which is much less than previous values. Secondary deuterium and tritium intensities were measured and a value obtained for the global average production of tritium in the earth's atmosphere. (auth) (STAR)

46184 (TID-4005(Pts.3 and 4)(2nd Ed.)) SUMMARIES OF PHYSICAL RESEARCH IN PHYSICS AND MATHEMATICS. (Division of Research (AEC), Washington, D. C.). Apr. 1967. 412p. Dep. CFSTI.

The summaries cover both on-site and off-site research in low-energy and medium-energy physics and in mathematics and computers. (D.L.C.)

46185 DIRECT METHOD SHOWING THE EXISTENCE OF LARGE AIR SHOWERS DUE TO PRIMARY PHOTONS. Catz, Philippe; Gawin, Jerzy; Hibner, Julius; Herbelleau, Francoise; Maze, Roland; Wdowczyk, Jerzy; Zawadski, Alexander (Laboratoire de Physique Cosmique, Verrieres-le-Buisson, France. Univ. of Lodz, Poland). Compt. Rend., Ser. A and B, 265: 84-7 (July 3, 1967). (In French).

The existence of abnormal showers by a new data processing method which leads to a direct representation of their effect was shown. The investigation showed direct evidence of the existence of a group of showers at normally poor in muons. It is thought that these come from primary photons produced in sources situated well beyond the galaxy and in which the acceleration processes of the charged particles is in competition with that of destruction by collision. (tr-auth)

46186 COSMIC-RAY STUDIES IN INTERPLANETARY SPACE AND ON THE MOON. Vernov, S. N.; Chudakov, A. E.; Vakulov, P. V.; Logatchev, Y. I.; Lyumbimov, G. P.; Nikolaev, A. G.; Pereslegina, N. V. Spaceflight, 168-75(Sept. 1967).

Studies in such remote regions as the orbits of Mars and Venus, and the Moon's surface, are described under the following headings: cosmic-ray intensity changes during the 11-year solar activity cycle; energy spectrum of the 11-year variation; radial gradient of cosmic rays; time shift of cosmic-ray variations; low-energy proton bursts; the Moon and cosmic-ray intensity variations. (UK)

46187 MODULATION OF GALACTIC COSMIC RAYS BY PROCESSES IN THE ACTIVE REGIONS OF THE SUN. Nikolaev, Yu. M. (Moscow State Univ.). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 134-5(1967).

Translated from Geomagn. Aeronomiya, 7: 174-6(1967).

A formula is derived for determining the intensity gradient and modulated intensity of cosmic rays. (J.H.M.)

46188 COSMIC-RAY DISTRIBUTION AND THE ACCEPTANCE VECTORS OF DETECTORS. II. METHODS OF STUDYING COSMIC-RAY DISTRIBUTION. Krymskii, G. F.; Kuz'min, A. I.; Chirkov, N. P.; Krivoshapkin, P. A.; Skripin, G. V.; Altukhov, A. M. (Inst. of Cosmophysical Investigations and Aeronomy, Academy of Sciences, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 7-10(1967).

Translated from Geomagn. Aeronomiya, 7: 11-15(1967).

The method of diurnal variations, the spherical analysis method, and the method of zonal harmonics are examined and the possibilities of these methods are discussed. (auth)

46189 DETERMINATION OF THE TRUE WAVES AND PARAMETERS OF SIMULTANEOUS AMPLITUDE–PHASE MODULATION OF THE PERIODIC COSMIC-RAY VARIATION FROM EXPERIMENTAL DATA ON SIDE FREQUENCIES. Dorman, L. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 11-16(1967).

Translated from Geomagn. Aeronomiya, 7: 16-22(1967).

A solution is obtained of equations for previously reported side frequencies. A method is developed for determining the parameters δ_s, φ_s, δ_l, and φ_l of the simultaneous amplitude–phase modulation of the periodic cosmic-ray variation from experimentally found side frequencies with a frequency $\omega \pm m\omega_1$ in the possible presence of true waves with frequencies up to $\omega_0 \pm (m-1)\omega_1$. Formulas are also presented that make it possible to find subsequently the fundamental wave and all true waves. (auth)

46190 POSSIBLITY OF DETERMINING COSMIC-RAY VARIATION INTENSITY FROM STELLAR TIME. Dorman, L. I.; Inozemtseva, O. I.; Mazaryuk, E. A.; Solov'eva, Z. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 17-21(1967).

Translated from Geomagn. Aeronomiya, 7: 23-8(1967).

The possibility of determining the true stellar–diurnal wave is examined. Formulas for the simultaneous amplitude–phase modulation of solar–diurnal variations are used to develop a method of accounting for false effects in the analysis of stellar–diurnal variations. Data on the neutron and hard components from the network of cosmic-ray stations are analyzed for the period of declining the minimum solar activity. The true stellar–diurnal wave is found from the data of crossed telescopes at Krasnaya Pakhra and Itabashi stations; it has an amplitude of ~0.1% for the 1962–1964 period. (auth)

46191 EFFECTIVENESS OF MAGNETIC STORMS THAT ARE INEFFECTIVE IN COSMIC RAYS. Luzov, A. A.; Lopato, T. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 22-4(1967).

Translated from Geomagn. Aeronomiya, 7: 29-32(1967).

The intensity of the neutron component of cosmic rays during magnetic storms that are ineffective in cosmic rays is analyzed. (auth)

46192 MUONS PRODUCED BY NEUTRAL COSMIC RAYS AS A FUNCTION OF SIDEREAL TIME. Buckwalter, Gary L. Washington, D. C., Catholic Univ. of America, 1966. 36p.

Thesis.

A rather massive liquid scintillation system enclosed by an anticoincidence shield is described in detail. This system was to be capable of confirming a previously reported diurnal sidereal variation in the neutral cosmic rays. Data are reported showing that muons which are produced by neutrals in the target do not follow a simple Poisson distribution. That is, they may be distributed nonrandomly in time. Further, it is shown that the neutral-produced muons do indeed demonstrate a marked sidereal effect. No mechanism is postulated for the initial interaction, but some possibilities are discussed. Future work and other interesting capabilities of the detector are considered. (Disser. Abstr.)

46193 INTERPRETATION OF ATMOSPHERIC FLUORESCENCE SIGNALS FROM MULTI-JOULE COSMIC-RAY AIR SHOWERS. Jenkins, Edward Beynon. Ithaca, N. Y., Cornell Univ., 1966. 212p.

Thesis.

An investigation was made on the feasibility of an experimental approach which is capable of registering large air showers at a distance of up to ten or fifteen kilometers away from the apparatus. The method of detection embodies the nighttime observation of a weak fluorescence radiation emitted isotropically from nitrogen molecules excited by the air shower's secondary electrons. Laboratory measurements of the light yield from air undergoing particle bombardment indicate that the optical signal within 3,000 to 4,000 Å from a shower should be of sufficient intensity to be detectable by an apparatus of moderately ambitious design. The technique's effectiveness is chiefly limited by an obscuration of the desired signal by a photoelectron statistical fluctuation noise generated by the presence of background illumination in the night sky. A study on the relevance of various apparatus design parameters to the detection efficiency and overall counting rate is presented. Over a three year period a pilot experiment was operated in an attempt to observe actual cosmic ray events by the proposed method. Three stations were constructed each having five fourteen-inch diameter photomultiplier tubes capable of wide angle viewing, which were directed toward different, overlapping sectors of the night sky. The measurement of simultaneous signal amplitudes from three or more phototubes indicates the intensity and direction of the received light flux as a function of time, from which the shower's developmental character and direction may be determined. The lack of significantly recognizable events over an accumulation of one thousand hours of observing clear, moonless night skies sets an upper limit to the flux of primary particles as a function of energy. Concurrent with the equipment operation a study was made on the exact nature of the signals which one might expect from large air showers, together with the derivation of a method specifically applicable to the pilot experiment for analyzing such signals in the presence of noise. Specific examples of the analyses of computer simulated pulses are presented to demonstrate the nature and magnitude of the uncertainties to be expected for various shower parameters. A survey was also made on the general problems associated with the detection and interpretation of the brief light signals. (Disser. Abstr.)

Direct Energy Conversion

46194 (N-67-25075) DIAGNOSTICS OF MHD GENERATOR PLASMAS. Kruger, C. H.; Mitchner, M.; Eustis, R. H. (Stanford

Univ., Calif. Plasma Gasdynamics Lab.). Feb. 28, 1967. Contract NAS3-6261. 60p. (NASA-CR-54667). CFSTI.

A noble-gas MHD generator was constructed and its performance measured. Wall leakage and Hall effects seriously degraded the generator performance. A spectroscopic interference-filter photographic technique was devised for spatially resolving the electron temperature distribution, and microwave measurements showed nonequilibrium electron concentration after expansion in a supersonic nozzle. The effect of the electric field on the electron distribution function was determined, and procedures for calculating electrical conductivity and Hall parameter were evaluated. Theoretical calculation of current distribution in segmented MHD generators showed important effects of temperature or conductivity gradients. (auth) (STAR)

46195 DIRECT CONVERSION OF GAMMA RAY ENERGY INTO ELECTRIC ENERGY. Eyraud, Charles; Lenoir, Jeannine; Jenin, Pierre (Faculte des Sciences, Lyon. Institut National des Sciences Appliquees, Villeurbanne, France). Compt. Rend., Ser. C, 265: 217-20(July 24, 1967). (In French).

The gamma energy of a radioelement (^{60}Co, ^{137}Cs, etc.) can be converted directly into electric energy by electrochemical recombination of the products of radiolysis. A new type of sealed cell, of which the stability with time is related to the period of the emitter, is proposed. (tr-auth)

46196 HIGH-GRADE IONIZATION IN COLD GAS. Halasz, D.; Szendy, Ch. (Projecting Inst. for Power Stations and Networks, Budapest). Acta Tech. Acad. Sci. Hung., 58: 169-80 (1967).

In all magnetohydrodynamic (MHD) devices a high degree of ionization (10^{21} to 10^{24} electron–ion pairs per m^3) is needed to obtain the desired conductivity (10 to 100 mho/m). At present, this can practically be attained only by applying a high temperature (2500 to 3000°K). There are, however, important applications (nuclear MHD power plants, MHD compressors, etc.) where a high temperature is not feasible. It is therefore important to have some means by which the required high degree of ionization may be obtained simply, safely, and economically at a moderate temperature (150 to 500°C). The process described is based on a well-known fact, a mathematical analysis of which is given, that for a short time (10^{-2} to 10^{-3} sec) a large temperature difference (1000 to 3000°K) can exist between a gas and a fine solid particle (d = 10^{-7} to 10^{-8} m) floating with zero relative velocity in it. This time must be slightly longer than that during which the particle travels along the magnetized section of the generator (compressor) duct. The temperature of the solid particle is raised by fitting a ceramic or other suitable material, as a ceramic ring, into the duct wall, thermally insulating it from the remaining part of the wall structure, and keeping it at a high temperature (2000 to 3300°K), so that its radiation will heat the particle while the working fluid remains practically cold because it does not absorb radiation heat. This condition is almost completely fulfilled by a noble gas in a nuclear MHD power plant or the air in a MHD compressor. (BBB)

46197 OPTIMAL CONDITIONS IN THERMIONIC CONVERTERS WITH AN ARBITRARY NUMBER OF COLLISIONS. I. Maev, S. A.; Stakhanov, I. P.; Gus'kov, Yu. K.; Zyukov, V. I.; Pashchenko, V. P. Zh. Tekh. Fiz., 37: 1079-89(June 1967). (In Russian).

The method of H. Grad involving expansion of the distribution functions in series of generalized Hermite polynomials was used to calculate the parameters of a cesium-diode-type thermoelectric converter under conditions of no volume ionization but with arbitrary values of the ratio of the electron mean free path to the electrode gap length. The transport equations are derived from Boltzmann's equation in the 8-moment approximation with the hard-sphere value for the collision integral. The boundary conditions that were derived elsewhere by Maev (Teplofiz. Vys. Temp., 3: No. 2 (1965)) are simplified with the aid of the assumptions that the effect of the temperature gradients on the boundary values of the potential and the charged particle temperatures and densities is negligible and that the neutral component of the plasma is at rest with respect to the electrodes. The transport equations and boundary conditions are employed to calculate the behavior of the converter in the case when the degree of ionization of the plasma is so low that collisions between the electrons and ions can be neglected. The expression obtained for the saturation electron current reduces to known expressions for the cases when the electron mean free path is much shorter or much longer than the electrode gap, and it is believed that the derived relations also give a good description of the behavior of the converter in the intermediate case when the electron mean free path is comparable to the electrode gap. (ATD)

46198 ENGINEERING ASPECTS OF MAGNETOHYDRODYNAMIC POWER GENERATION. Horn, G. (Berkeley Nuclear Labs., Eng.); Hughes, E. M. Trans. Inst. Chem. Eng. (London), 45: T182-9(June 1967).

Investigations into the magnetohydrodynamic generation of electricity are described, including the use of an experimental generator of 200-MW thermal input and pilot plant studies of high-temperature air-heating systems. Some problems in designing the combustion chamber, magnet, and MHD duct for a full-scale plant, and the way these problems have been tackled in the experimental generator which will operate on kerosene and oxygen, are discussed. For commercial operation, oxygen was uneconomic and to obtain the required combustion temperature of about 2500°C an air preheat of at least 1200°C was required. Various forms of air heater were assessed for this duty and experiments in progress are described. To enhance gas conductivity, seeding chemicals were introduced into the combustion chamber. The chemical engineering problems of handling and recovering the corrosive seed material are referred to. (BBB)

46199 PROGRESS IN THE FIELD OF MHD ENERGY CONVERSION. Nikolopoulos, P. N. ETZ (Elektrotech. Z.), B, 18: 803-5(Oct. 21, 1966). (In German).

Recent advances in techniques and instrumentation in magnetohydrodynamic (MHD) energy conversion are reviewed, including a description of MHD generators with closed circulation of the working material, with noble gases as the working material; with liquid metals as the working material; and with open circulation with combustion gases as the working material. The chief task for closed circulation has been development of simple methods for increasing electrical conductivity of the working gas through nonequilibrium ionization. Other problems include offsetting inner channel losses and end losses, but technological problems are less for closed than for open systems. Several new devices utilizing liquid metal are reported; a difficult problem with liquid metals is acceleration of the metal to the generator canal. Open circulation generators are discussed, with particular attention to the developments by the Avco-Everett Research Laboratory. Several French, American, Polish, and German devices are also described. Problems remaining include development of temperature-stable materials for the generator canal and the development of superconducting magnet cores. (BBB)

46200 OPTIMAL CONDITIONS IN THERMIONIC CONVERTERS WITH AN ARBITRARY NUMBER OF COLLISIONS. II. Gus'kov, Yu. K.; Zyukov, V. I.; Maev, S. A.; Pashchenko, V. P.; Stakhanov, I. P. Zh. Tekh. Fiz., 37: 1090-1104(June 1967). (In Russian).

The theoretical work of an earlier paper by the authors (ZhTF, 37: 1079, 1967) on the behavior of a cesium-diode-type thermoelectric converter under conditions of no volume ionization but with arbitrary values of the ratio of the electron mean free path to the electrode gap length is continued and the results are employed in a discussion of the optimal conditions for operation of the converter. The boundary conditions at the cathode are derived separately for the cases of positive and negative potential discontinuity, the current–voltage characteristics are calculated, and the values of the pressure, electrode gap length, and cathode temperature for maximum current and maximum power are determined. Some of the calculated values are compared with experimental data: good agreement was generally found, but some discrepancies were noted and are discussed briefly. A two-dimensional classification of the operating conditions of a converter is proposed, and the potential distribution in the gap and the short-circuit current is given for each class of operating conditions. The operating conditions are classified on the one hand as quasi-vacuum, gas kinetic, diffusion, or arc, and on the other hand as undercompensated or overcompensated, depending on the sign of the potential discontinuity at the cathode. A few general conclusions are drawn concerning the optimal operating conditions. Most advantageous is the case when the converter operates under equilibrium conditions with the output current equal to half the limiting current, which is of the order of magnitude of the equilibrium random current, the electron mean free path approximately equal to the electrode gap length, and the pressure of the order of 0.1 to 0.5 mm Hg. These operating conditions require a high cathode temperature, and the work function should be independent of the cesium pressure. If the cathode work function depends on the pressure, optimum operation is achieved at much higher pressures under low-voltage arc conditions, with an interelectrode distance equal to 20 to 30 electron mean free paths. The interelectrode distance can be considerably greater in the case of a converter with surface ionization. (ATD)

46201 STATE OF ADMIXTURES IN CESIUM USED IN A THERMIONIC CONVERTER. Subbotin, V. I.; Ivanovskii, M. N.;

Arnol'dov, M. N. (Physical Power Inst., Moscow). Teplofiz. Vys. Temp., 5: 377-9(Mar.-Apr. 1967). (In Russian).

An investigation was made of the behavior of Cs_2O, CsH, and CsOH both in the cesium container and in the cesium vapor of a thermionic converter. The study showed that the container cannot be the source of the oxygen present in the cesium vapor, which fact precludes the removal of the oxygen from molten cesium. Oxygen in the form of Cs_2O can become in cesium a kind of a "getter," forming CsOH. CsH in molten Cs dissociates almost completely. Part of the H interacts with Cs_2O, forming CsOH, and the excess H remains in gaseous form in the container and in the interelectrode spacing. In the Cs vapor, the equilibrium state of the admixtures depends on the temperature and materials of the converter. Oxygen can be present in the form of gas and of oxides of the cesium and metals of which the surfaces of the diode are constructed. The measurements indicated that at a temperature of 300°C practically all oxygen is concentrated in the container, independently of the electrode materials. In the region of the diode, all the oxides are less stable than the Cs_2O in the container, and the oxygen should pass into the container. It is possible that in the interelectrode spacing water vapor will form and be absorbed in the container, thus producing CsOH. (ATD)

46202 EFFECT OF FLOW VELOCITY ON A SINGLE, CONTROLLED GLOW DISCHARGE IN CESIUM-SEEDED ARGON. Evans, Norman A. (General Electric Space Sciences Lab., King of Prussia, Pa.). AIAA (Amer. Inst. Aeronaut. Astronaut) J., 5: 1908-10(Oct. 1967).

An attempt is made to determine the effect of gas velocity and magnetic field (separately and combined) on the discharge characteristics of electrode pairs. Ellington's experimental cesium-seeded argon static-diode results [AERE-M-1616 (July 1965)] are used as a starting reference point for the experiment. Data are plotted which show optimum channel seed ratio, optimum positive column seed ratio, optimum channel operation, cathode loss vs. seed ratio, and anode loss vs. seed ratio. (J.H.M.)

46203 CYCLE ANALYSES FOR LIQUID-METAL POWER CONVERSION SYSTEMS USING A BIFLUID MHD GENERATOR. Sense, Karl A.; Gelb, George H. (TRW Systems, Redondo Beach, Calif.). AIAA (Amer. Inst. Aeronaut. Astronaut) J., 5: 1818-22 (Oct. 1967).

Parametric cycle analyses for power generation using a bifluid, liquid-metal, MHD generator were carried out for Rb–Li, Cs–Li, K–Li, and Na–Li fluid pairs at two heat-source temperatures: 2460°R (SNAP-50) and 1760°R (SNAP-8). At the higher heat-source temperature, the Rb–Li fluid pair is found to be superior to the other fluid pairs (zero solubility assumed) from the standpoint of cycle efficiency and specific radiator area (weight). At the lower temperature either the Rb–Li or Cs–Li system is best, depending upon the minimum fluid void fraction required for satisfactory operation. Operation at the lower heat-source temperature but the same Carnot efficiency is distinctly inferior both from the standpoint of cycle efficiency and specific radiator weight. At the lower heat-source temperature, the cycle efficiencies are shown to be particularly sensitive to the parasitic pressure losses of the system and are penalized by low separator efficiencies. (auth)

46204 MAGNETOHYDRODYNAMIC GENERATORS. (to Siemens-Schuckertwerke Aktiengesellschaft). British Patent 1,086,755. Oct. 11, 1967. Priority date Feb. 19, 1964, Germany.

A magnetohydrodynamic generator is described in which, when the generator is in operation, the plasma is caused to flow between two opposed surfaces of two electrodes. The electrodes are provided with cooling channels which extend behind the opposed surfaces. The arrangement is such that the electrodes can be cooled by the passing of coolant through the cooling channels, during operation of the generator. In order to supply and discharge the coolant, more than two passageways are provided to each of the cooling channels. (J.H.M.)

46205 MAGNETOHYDRODYNAMIC GENERATORS. (to Siemens-Schuckertwerke Aktiengesellschaft). British Patent 1,086,610. Oct. 11, 1967. Priority date June 12, 1965, Germany.

A method is described for generating electricity by means of an MHD generator operating with a gaseous medium obtained from the combustion of fuel. The seed material, which is in the form of a solid at room temperature, is heated to such a temperature that it is fluidized and undergoes chemical decomposition, by way of an endothermic reaction, and is then supplied in its decomposed form, as a fluid, to the combustion chamber of the generator. (J.H.M.)

46206 THERMIONIC ENERGY CONVERTER. (to Brown, Boveri and Cie Aktiengesellschaft). British Patent 1,086,580. Oct. 11, 1967. Priority date Feb. 25, 1965, Germany.

A thermionic converter with emitter and collector electrodes located at a small distance apart is described. The space between the emitter and electrodes is filled during use with cesium vapor, and the space between the electrodes is filled during use with the vapors of an alkaline earth metal and a halogen, or with the vapor of a compound containing an alkaline earth metal and a halogen. (J.H.M.)

46207 AN MHD CONVERTER. Weh, Herbert. British Patent 1,087,275. Oct. 18, 1967. Priority date Feb. 14, 1964, Germany.

The MHD energy converter described of comprises a flow channel to guide the electrically conducting liquid and at least one winding to produce a magnetic field that passes through the flow channel substantially transversely of the longitudinal extension of the channel. The flow channel is curved in the region of the energy conversion so that its center line forms a section of a circle. This flow channel is bordered radially inwards by a toothed rotor which is mounted free to rotate and serves to close the path of the magnetic field. (M.H.R.)

46208 IMPROVEMENTS IN OR RELATING TO MAGNETO-HYDRODYNAMIC GENERATORS. Chapman, Alan George (to Associated Electrical Industries Ltd.). British Patent 1,088,173. Oct. 25, 1967. Filed Apr. 26, 1965.

A nozzle is described which is suitable for use in a magneto-hydrodynamic generator as part of the main gas flow duct. This is to provide a streamline transition between a first part of the duct of circular cross section and a second part of the duct of rectangular cross section. This nozzle has walls formed by a multiplicity of tubes which lie side by side with their lengths extending in the general direction of the gas flow along the duct. Two of the walls extend substantially parallel to each other and the other walls extend between these two walls and are profiled to substantially arcuate cross section at the inlet end of the nozzle and substantially flat and parallel cross sections at the outlet end of the nozzle. Preferably the tubes are of rectangular cross section. (M.H.R.)

Fluid Physics

Refer also to abstract 45294.

46209 (N-67-18990) CONTINUUM ELECTROMECHANICS GROUP ELECTROMECHANICAL CO-STREAMING AND COUNTER-STREAMING INSTABILITIES. Ketterer, Frederick D. (Massachusetts Inst. of Tech., Cambridge. Center for Space Research). Aug. 1966. 55p. (NASA-CR-82482; CSR-TR-66-15). CFSTI.

The dynamics of two highly conducting, finite-length streams in relative motion, coupled by a transverse electric or longitudinal magnetic field are examined in detail. The systems may be mathematically described by two second-order coupled hyperbolic partial differential equations. Four classes of flow exist: (1) subcapillary, (2) supercapillary co-streaming, (3) supercapillary counter-streaming, and (4) subcapillary–supercapillary flow. The first three are considered. The behavior of the infinitely long system is examined from the dispersion relation and the Bers–Briggs stability criterion. The eigenvalue problem is formulated for class (1) and (3) flows (no eigenvalues exist for class (2) flow) and the complex eigenfrequencies computed. Electrohydrodynamic experiments on these systems are described and compared with the theory. Physical explanations are given for the observed instabilities. (auth) (STAR)

46210 (LA-tr-67-33) ELECTROMAGNETIC VELOCITY GENERATION IN ELECTRIC ARC JET ENGINES. Kruelle, Gerhard; Huegel, Helmut. Translated by A. D. Cernicek (Los Alamos Scientific Lab., N. Mex.), from Z. Flugwiss., 14: 323-33(1966). 30p. Dep. CFSTI. JCL $3.60 fs, $1.16 mf.

The exhaust velocity of continuously operating electric arc jet engines may be considerably increased by electromagnetic forces. The effect of self-magnetic Lorentz forces on the features of supersonic flows is discussed. By means of hydrogen as a working gas, mean velocities up to 50,000 m/sec are measured by a thrustor in which the plasma is additionally accelerated by Hall effects. (auth)

46211 A GENERALIZED OPTIMAL PERFORMANCE CHART FOR THE CONSTANT VELOCITY FARADAY MHD GENERATOR. Kennedy, Warren C. (Carnegie Inst. of Tech., Pittsburgh). Proc. IEEE (Inst. Elec. Electron. Eng.), 55: 1651-3(Sept. 1967).

The well-known performance equations for the constant-velocity MHD Faraday generator employing a fluid of constant conductivity are rewritten in terms of a general performance parameter Q. These equations are plotted for various constant values of Q in such a way as to make the resulting plot a general performance chart. From this chart general optimal operating conditions are deduced. (auth)

46212 DINAMIKA RAZREZHENNOGO GAZA. KINETICHESKAYA TEORIYA. (Rarefied Gas Dynamics. Kinetic Theory). Kogan, M. N. Moscow, Izdatel'stvo Nauka, 1967. 440p.

The basic concepts of the kinetic theory of gases are reviewed in the first chapter. The second and the third chapters are devoted to the developing of kinetic equations and general methods of resolution; the methods may be applied to the studies of neutral molecular gases and to the theory of plasma. In the fourth chapter various specific uses of the methods are illustrated. The maximum cases of gas flow at small and large Knudsen numbers are discussed in the fifth and sixth chapters. (R.V.J.)

Geophysics

Refer also to abstracts 46090, 46135, and 46454.

46213 (AD-647794) RESEARCH WORKS RELATED TO SOLAR RADIO EMISSION AND V.L.F. PROPAGATION IN THE LOWER IONOSPHERE. Annual Report, January 1966-January 1967. Kaufmann, Pierre (Universidade Mackenzie, Sao Paulo (Brazil). Grupo de Radio-Astronomia). Contract DA-ARO-49-092-65-G76. 151p. (GRAM-23). CFSTI.

Progress is reported on lower ionosphere research under the following topic areas: installation of very low frequency tracking stations at Umuarama radio observatory; D-region modifications during sudden ionospheric disturbances; approximated calibration curves for the Sao Paulo vlf tracking receivers; a May 20, 1966, annular solar eclipse effects on vlf propagation path Criggion-Sao Paulo; computation of average amplitude of vlf transmissions; measuring methods with a new 7 GHz solar radio polarimeter: first results relative to solar activity from October 30 to November 14, 1966; technical features of a new solar radio polarimeter working on 4.28-cm wavelength; calculations of apparent sky temperatures and of tropospheric absorption on solar radiation at 4.28-cm wavelength; description of trapped particle distribution at 900-km of altitude near the South Atlantic geomagnetic anomaly; and influence of zenith distance on atmospheric absorption due to water vapor and oxygen at the frequency of 17 GHz. (TAB)

46214 (N-66-31887) MEASUREMENT OF UPPER ATMOSPHERIC IONIZATION AND WINDS WITH A COMBINED PAYLOAD. Interim Report. Smith, L. G.; Bedinger, J. F.; Best, G. T. (GCA Corp., Bedford, Mass. GCA Technology Div.). June 1966. Contract NASw-1083. 104p. (NASA-CR-76462; GCA-TR-66-11-N). CFSTI.

The relation between the structure of the electron density profile and wind in the E region is being studied using sounding rockets to obtain the electron density profile and to lay down the vapor trail used in obtaining wind data. A payload was developed which combines the canister of the vapor trail technique with Langmuir probe instrumentation for electron density observations. Several combined probe and vapor train payloads were constructed, including both TMA (trimethyl aluminum) and alkali vapor canister sections, and launched at Wallops Island and Fort Churchill. Details of the launches are discussed. The results of electron density and wind observations are also given. Spectral observations of sunlit trails were obtained with a spectrophotometer. This investigation and the temperature obtained are discussed. A similar instrument was used to observe the Comet Ikeya-Seki near Hawaii from an aircraft. These results are also presented. Some conclusions concerning the experimental methods and data as well as recommendations for future work are presented. (STAR)

46215 (N-67-17812) LE MISURE DI TEMPERATURA ELETTRONICA NELLA IONOSFERA E L'ERRORE INTRODOTTO DALL'IMPIEGO DI GRIGLIE PER L'ANALISI ALLA LANGMUIR. (The Measurements of Electron Temperature in the Ionosphere and the Error Introduced by the Use of Grids for Langmuir Analysis). Bruscaglioni, P. (Consiglio Nazionale delle Ricerche, Florence (Italy). Centro di Studio per la Fisica delle Microonde). Apr. 1966. 25p. (In Italian). (CM-R-33-10.3). Dep.

An analysis is made of the error introduced by the nonhomogeneity of electrostatic potential on the plane of a probe described in a previous report (CM-R27-10.1), when Langmuir analysis is made. It is shown that the error can be maintained small by means of a careful choice of the grid structure. (auth) (STAR)

46216 (N-67-18234) PLASMA IN THE MAGNETOSPHERE. Scarf, Frederick L. (TRW Systems, Redondo Beach, Calif. Space Sciences Lab.). Dec. 15, 1966. Contract NASw-1366. 109p. (NASA-CR-81759). CFSTI.

The earth and its magnetic field form an obstacle in the path of the continuously streaming collisionless plasma which represents the outer corona of the sun, and this solar wind compresses and distorts the geomagnetic dipole field into a cavity which is referred to as the magnetosphere. The distorted geomagnetic field appears to extend over a huge tail region in the anti-solar direction, and present estimates of the tail length are on the order of one-thousand earth radii, or more. The magnetosphere contains a very complex distribution of charged particles and it represents a valuable plasma laboratory in which wave propagation, containment, injection, local particle acceleration, plasma instabilities, and other non-linear phenomena can be studied without many of the difficulties and degrading effects encountered in the ground-based laboratory. In this review, a summary is presented of some of the more important characterics of this magnetosphere, and call attention to those areas which appear to be of greatest interest for plasma physics investigations. (auth) (STAR)

46217 (N-67-18353) LOW-ENERGY CHARGED PARTICLE ENVIRONMENT OF THE EARTH. Hess, W. N.; Mead, G. D.; Nakada, M. P. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). [1965]. 66p. (NASA-TM-X-57338). CFSTI.

Data on the radiation environment of the Earth are reviewed, with emphasis placed on the low-energy particles that cause degradation to thermal control surfaces. Protons in the range of 1 keV to 1 MeV, and electrons up to about 100 keV are considered. The measurements obtained from the Explorer, Pioneer, Mariner, and Lunik satellites are assessed in relation to the solar wind, the magnetosphere, the transition zone and shock wave, radiation belts, the aurora, and the low-energy particles. Integrated fluxes that can cause significant surface damage are considered, and times to damage for several components of the radiation environment are calculated. A bibliography of references is included. (STAR)

46218 (N-67-18653) SATELLITE MEASUREMENTS OF MAGNETIC FIELDS IN SPACE. Ness, Norman F. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Nov. 1965. 25p. (NASA-TM-X-57116). CFSTI.

Direct measurements of the physical properties of cislunar space by satellites and space probes confirmed the existence of solar wind and the continual confinement of the geomagnetic field, as well as the development of an extended magnetic tail of the earth. On the nightside of the earth the terrestrial field trails out in a highly distorted fashion at least halfway to the moon. The boundary area observed between the geomagnetic field and the undisturbed interplanetary medium was tentatively identified as a collisionless magnetohydrodynamic shock wave. Gross characteristics of the distorted magnetic field, its boundary layer, and the recently observed detached bow shock wave were discussed in detail. (STAR)

46219 (N-67-18713) ELECTRON AND PROTON FLUXES IN THE TAIL OF THE MAGNETOSPHERE. Konradi, Andrei (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Nov. 1965. 26p. (NASA-TM-X-57080). CFSTI.

Observation and energy spectra of electrons and protons in islands at the back of the magnetosphere are shown to be typically for electrons $J(>2\ keV) \leq 8 \times 10^6/cm^2\text{-sec-ster}$, and for protons $J(>125\ keV) < 10^4/cm^2\text{-sec-ster}$. The electron spectra for particles with $20\ keV < E < 70\ keV$ can be characterized by e-folding energies ranging from 15 to 5 keV or by γ from 2.6 to 4.3 for differential power law spectra. For protons with energies $E > 125\ keV$ the spectra display e-folding energies in the range from 20 to 40 keV for γ between 7.8 and 4.9. The electron spectra in the islands show a characteristic softening with time. A comparison is made with electron fluxes observed with the Alouette, IMP-1, and Vela satellites. The similarity between particles in the islands and those observed in the aurora is discussed. (auth) (STAR)

46220 (N-67-18771) JUPITER'S MAGNETOSPHERE. Gledhill, J. A. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Feb. 1967. 11p. (NASA-TM-X-55704). CFSTI.

A magnetospheric model of Jupiter is presented which shows the maximum plasma densities that can co-rotate with the planet. First an estimate is made of the maximum number density of the plasma in the equatorial plane by equating the magnetic and rotational kinetic energy densities. Then a method is used to calcula the distribution of plasma along the line of force. It is shown that the effect of the centrifugal force is to confine the plasma to a discus-like region about the plane at 7° to the equatorial plane. Details and refinements of these calculations are not included. (ST

46221 (N-67-19100) STEADY STATE FLUID MODELS OF THE ION-EXOSPHERE. Gliddon, J. E. C.; Yeh, K. C. (Illinois Univ., Urbana. Electrical Engineering Research Lab.). Nov. 1966. 58p. (NASA-CR-82486). CFSTI.

An ion exosphere can be defined as the uppermost part of the ionosphere in which the self-collision time is much larger than the time required for ions to travel between mirroring points. The system is entirely controlled by externally applied forces and long-range Coulomb forces. Assuming that the Lorentz force is dominant and that the heat transport is negligible, a closed system of hydromagnetic equations can be derived by taking successive moments of the Vlasov equation. This system of equations is often referred to as the CGL theory, in which the two equations of state are equivalent to the requirement that the magnetic moment and the longitudinal invariant be adiabatic invariants. A magnetohydrostatic solution of the CGL equations is given. The dilute plasma is assumed to be in a gravitational field, permeated by a strong dipole magnetic field and rotating with constant angular velocity about the dipole axis. These equations are solved in the dipole coordinate system by assuming that the ion exosphere is either in adiabatic equilibrium or in isothermal equilibrium. Analytic expressions for the density, the elements of the pressure tensor, and the temperature of the fluid have been derived. A formula for the ring current has also been found. The results are illustrated by a number of representative curves. (auth) (STAR)

46222 (N-67-23964) ON THE ION COMPOSITION AND TEMPERATURE IN THE TOPSIDE IONOSPHERE. Mayr, H. G.; Brace, L. H.; Dunham, G. S. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Dec. 1966. 57p. (NASA-TM-X-55740; X-621-66-573). CFSTI.

In the topside ionosphere the altitudinal distribution of protons in diffusive equilibrium deviates strongly from that in chemical equilibrium through charge-exchange with O^+. The particle continuity equations for H^+ and O^+ and the energy continuity equation are solved simultaneously by means of a computer program. The processes included are photoionization, charge-exchange, ambipolar diffusion along magnetic field lines, heat conduction, local and nonlocal heating, and heat loss from ions to neutrals. The ion composition and plasma temperature along various field lines are derived and studied by adopting electron density and temperature from Explorer-XXII measurements (1000-km altitude, vernal equinox) as boundary conditions. The $O^+ - H^+$ composition transition region at middle and low latitudes is fully described. It is found that a neutral hydrogen concentration of 2×10^8/cc at 500 km is required to make the calculated electron density consistent with satellite measurements of electron density at 650 km. (auth) (STAR)

46223 (SC-DC-67-1986) AIRBORNE SCANNING PHOTOMETER MEASUREMENTS OF CONJUGATE AURORA. Moore, James G. (Naval Weapons Center, China Lake, Calif.); Robertson, Merton M. (Sandia Corp., Albuquerque, N. Mex.). July 1967. Contract AT(29-1)-789. 6p. Dep. CFSTI.

Observations were made by a six-color photoelectric scanning photometer in each of two jet aircraft which flew pre-calculated conjugate paths across the northern and southern auroral zones. The colors that were chosen were those of OI at 5577 A and 6300 A and N_2^+ at 3914 A as well as 4012 A, 5605 A, and 6203 A. The observations indicate that auroras are present simultaneously at conjugate points and that the intensities of the same emissions seem to covary in both hemispheres. (J.H.M.)

46224 POLARIZATION OF HYDROMAGNETIC Pc-1 (PEARLS) OSCILLATIONS IN MAGNETICALLY CONJUGATED POINTS SOGRA (SSSR) AND KERGUELEN (FRANCE). Gokhberg, M.; Zhendren, R.; Lakurli, S.; Malevskaya, O.; Troitskaya V. (Inst. of Physics of the Earth, Moscow). Dokl. Akad. Nauk SSSR, 174: 576-9(May 21, 1967). (In Russian).

Pc-1 oscillations of the geomagnetic field appear periodically in magnetically conjugated points with a phase shift about 180°. It is believed that these oscillations are generated by hydromagnetic waves in the magnetosphere. Hydromagnetic waves propagate from one hemisphere to another along magnetic force lines. These waves have been analyzed in order to determine the cause of Pc-1 oscillations. The study was based on data simultaneously obtained in two magnetically conjugated points, Sogra in the Soviet Union and Kerguelen Island. The polarization of Pc-1 oscillations was studied from components of the geomagnetic field in the horizontal plane and from sequels simultaneously recorded on sonograms. The counterclockwise rotation of the geomagnetic vector causes a left polarized wave in the Northern Hemisphere and a right polarized wave in the Southern Hemisphere. The direction of the rotation in simple cases is stable, but there are cases when the left and right polarizations exist in the same point. In Pc-1 series with a complex structure a change of polarization direction is possible. The following conclusions were reached on the basis of the investigations: (1) hydromagnetic Pc-1 oscillations propagate with the same polarization from one hemisphere to another; (2) in the case of the superposition of several series of such oscillations with different frequencies, both equal and inverse polarizations can be observed at conjugated points; and (3) oscillations exhibit elliptical, not circular polarization as predicted by the theory. The major axis of the ellipse is stretched out in a north–south direction. (ATD)

46225 SIMULTANEOUS APPEARANCE OF Pc-1 MICROPULSATION FLASHES IN CONJUGATED POINTS. Gokhberg, M.; Zhendren, R.; Lakurli, S.; Troitskaya, V.; Shchepetnov, R. (Inst. of Physics of the Earth, Moscow). Dokl. Akad. Nauk SSSR, 174: 828-9(June 1, 1967). (In Russian).

An analysis was made of a combination of Pc-1 and Pi-1 magnetic oscillations which have decreasing periods. These perturbations, known as storm pulsations, solar whistles and gurgles, represent the basic element of the microstructure of magnetic storms and serve as indicators of developing ionospheric disturbances, auroras, and sudden changes in the intensity of radiation belts. Pc-1 and Pi-1 oscillations recorded at magnetically conjugated points (Sogra and Kerguelen) during February 1964–February 1965 are described. These oscillations have periods ranging from 30 to 90 minutes. The sonograms obtained made it possible to trace the development of the same phenomenon in conjugated points and to establish new characteristics of this phenomenon. The beginning and the end of the intensification of the noise belt occurred simultaneously at both conjugated points. An unexpected result of the comparison of sonograms was the coincidence of crosslinked elements at both points. The simultaneous excitation of Pc-1 oscillations in crosslinked elements on sonograms could also be traced on magnetograms. Analysis of the oscillation polarization has revealed that the direction of rotation of the polarization ellipse was the same for an observer looking along the force line toward the earth. Therefore, the individual Pc-1 excitations which appear during the appearance of gurgles have a different polarization than the analogous excitations within the Pc-1 series. The former excitations exhibit no phase shift in magnetically conjugated points. (ATD)

46226 MAGNETOACOUSTIC RESONANCES IN THE EXOSPHERE. Van'yan, L. L.; Zybin, K. Yu. (Inst. of Physics of the Earth, Moscow). Dokl. Akad. Nauk SSSR, 174: 1074-5 (June 11, 1967). (In Russian).

The nature and the origin of magnetoacoustic waves in the Earth's magnetic field are considered. In accordance with the modern concept, stable oscillations of the geomagnetic field having a period of from several seconds to several minutes owe their existence to the resonant hydromagnetic waves generated as a result of the interaction of the solar corpuscular stream with the outer regions of the Earth's magnetic field. The propagation of the hydromagnetic perturbations takes place in the form of Alfvén waves as well as magnetoacoustic waves. In the first case the stable oscillations are related to the appearance of Alfvén standing waves along the energy line, which is normally compared to an elastic string fastened on both ends. The fundamental period of the generated stable oscillations is in that case equal to twice the travel time of Alfvén waves along the energy line between the two conjugate points. In the second case the stable oscillations are thought to be due to the generation of standing magnetoacoustic waves in the resonator formed between the outer boundary of the magnetosphere and the well-conducting ionosphere. (TSS) (ATD)

46227 NATURE OF HYDROMAGNETIC WHISTLERS. Gul'el'mi, A. V. Dokl. Akad. Nauk SSSR, 174: 1076-8(June 11, 1967). (In Russian).

A modification of the existing theory of pearl-type micropulsations (whistlers) is developed to eliminate the presently encountered inconsistency in the ratio of carrier frequency to gyrofrequency. In regard to radiation mechanisms it is noticed that the cyclotron instability of protons in the external radiation belt cannot be responsible for the occurrence of the pearl-type micropulsations for two reasons: (a) the radiation spectrum of protons is wide and (b) the proton belt is an episodical phenomenon. The appearance of pearl-type micropulsations is apparently due to the sporadic entry of fast protons into the magnetosphere not yet detected by direct measurements aboard satellites. (TSS) (ATD)

46228 MAGNETOHYDRODYNAMICS OF THE EARTH'S EXOSPHERE. Moskvin, Yu. L.; Frank-Kamenetskii, D. A. (Moscow Physical-Technical Inst.). Dokl. Akad. Nauk SSSR, 174: 1079-81(June 11, 1967). (In Russian).

The equations of magnetohydrodynamics for an ideally conduct ing medium without dissipation are considered to show that two mechanisms can isolate a discrete spectrum of resonance frequencies from the surface noise and cause their propagation to the surface of the earth. (ATD)

46229 EFFECTS OF THE EARTH'S MAGNETIC FIELD ON THE PROPAGATION OF VERY LONG RADIO WAVES AROUND

THE EARTH. Baibulatov, R. B.; Krasnushkin, P. E. (Inst. of Mathematics, Moscow). Dokl. Akad. Nauk SSSR, 174: 84-7 (May 1, 1967). (In Russian).

The propagation of very long radio waves around the earth is analyzed mathematically, considering the two-dimensional waveguide effect produced by the earth and the ionosphere. (TSS)

46230 MOVEMENTS OF RADIO AURORA. Oksman, J. (Geophysical Observatory, Sodankyla, Finland). Geophysica, 9: 235-50(1966).

Backscattering of radio waves from auroral ionization (radio aurora) was discussed in terms of the geometry of auroral reflections recorded in static (radar) studies at some locations in Finland. Similar calculations for bistatic studies (transmitter and receiver separated) are reported for measurements made between Mikkeli and Sodankylä. The geographic coordinates of the transmitter are 27° 19'E, 61° 43'N. Its power is 9 kW and its antenna has an almost circular radiation pattern in the horizontal plane. The location of the receiver was 26° 39'E, 67° 22'N. A commercially available FM tuner was connected to a recorder. A 7½-min sample of the field strength from 2 directions was obtained 4 times an hour. The angle between the antennae was set at 45°. In the radar case the condition for strongest auroral scattering is with the angle between the radar beam and the direction of the magnetic field (propagation angle β) as close to 90° as possible. In the bistatic case the corresponding condition can be shown to be that the sum of the angles which the arriving and scattered waves form with the field line must be close to 180° as possible. How these sums can be determined for each pair of stations is explained. The auroral backscattering probably occurred above the north coast of Norway, from a distance of about 300 km. Although the line-of-sight distance to the transmitter was 700 km and the antennae were in the northerly direction, the possibility of receiving tropospheric waves from the transmitter with the backlobes of the antennae existed. It was thus necessary to distinguish between auroral echoes and tropospheric waves. How this distinction could be made from certain criteria is described. The bistatic measurements of radio aurora were analyzed and the results compared with calculated reflection conditions. Bending of radio waves in the E region of the ionosphere and change in the inclination of the geomagnetic field due to the auroral electrojet were estimated. Meridional and longitudinal motions of auroral ionization were deduced from the measurements. (BBB)

46231 ON THE FREQUENCY OF SUDDEN COMMENCEMENTS IN RELATION IN THE K_p INDEX. Schroeder, Wilfried (Geophysical Station, Bremen-Roennebeck, Ger.). Beitr. Geophys., 75: 261-4(1966). (In German).

Correlation of the planetary geomagnetic coefficient with the frequency of occurrence of sudden commencements is examined. Data are accumulated for 468 cases between 1932 and 1962. Association of 70% of the cases with $K_p \geq 5$ can be made; of the 30% where K_p is less than or equal to four, only 3% have $K_p \leq 2$. In years of minimum solar activity (R_{min} = 1933.8 and 1954.3) there is a low frequency of occurrences; there is still a preference for $K_p \geq 5$. For years of maximum solar activity, (R_{max} = 1937.4, 1947.5, and 1957.9), the preference for $K_p \geq 5$ is obvious. The $K_{p_{max}}$ and number of occurrences for the period total as follows: 0, 0; 1, 1; 2, 12; 3, 38; 4, 85; 5, 110; 6, 98; 7, 72; 8, 32; 9, 20. (BBB)

46232 FLUCTUATIONS IN THE FORMS OF THE AURORA. Schroeder, Wilfried (Geophysical Station, Bremen-Roennebeck, Ger.). Beitr. Geophys., 75: 265-7(1966). (In German).

Relations between isolated red spots of the aurora and geomagnetic activity (K_p, Q) are investigated. Several examples are chosen to show that these spots follow irregular pulsation, disappearing for a time and then appearing again. The auroras of March 28, 1959, and March 31, April 1, and August 17, 1960, occurred when K_p was between 7 and 9; the individual maxima and the Q index correlate well. Of 23 maxima, one occurred with Q = 5; three with Q = 6; seven with Q = 7; and twelve with Q = 8. Periods of maximum display are therefore coupled with rapid changes in geomagnetic activity. One may distinguish between variations of short duration (several sec) and those of long duration (up to 10 min). Generally speaking, a sort of transition is established for the case of the aurora. (BBB)

46233 OPTICAL UPPER ATMOSPHERIC INVESTIGATIONS AT THE UNIVERSITY OF SASKATCHEWAN. Hunten, D. M.; Rundle, H. N.; Shepherd, G. G.; Jones, A. Vallance (Univ. of Saskatchewan, Saskatoon). Appl. Opt., 6: 1609-23(Oct. 1967).

The history and philosophy of optical instrumentation for auroral and airglow studies, as developed at the University of Saskatchewan, is reviewed. Some details are given of the applications of grating spectroscopic systems, Fabry–Perot monochromators. Michelson interferometers, and birefringent and filter photometers with both photographic, photomultiplier, and photoconductive detectors. Finally, examples are given of the applications of these techniques to upper atmosphere temperature determinations, auroral excitation theory, auroral hydrogen arc studies, atmospheric alkali metals, and dayglow molecular oxygen emissions. (auth)

46234 GEOMAGNETIC PULSATIONS AND AURORAL ACTIVITY. Bossolasco, Mario; Caneva, Azzio; Elena, Antonio; Palau, Carlo (Univ., Genoa). Geofis. Meteorol. (Genoa), 16: 1-3(Jan.-Apr. 1967). (In Italian).

The term PSE (pulsation single effect) denotes a type of geomagnetic variation, with a period usually of 40 to 50 sec, in the form of isolated events of 2 or 3 single oscillations, progressively diminishing. The PSE presumably represents an interaction between the geomagnetic field and solar particulate radiation. On the basis of records of geomagnetic pulsations registered at Roburent (Province of Cuneo, Italy) from June 1965 to November 1966, it was demonstrated that the 1389 instances of PSE occurred with a frequency of nearly 90% during periods of auroral activity, as defined by the riometer records taken simultaneously at Great Whale River (Canada). The PSE, originating from the interaction of intense solar corpuscular emissions, are therefore also a phenomenon associated with the middle latitudes. By adoption of a simplified model of the magnetosphere, a numerical approach was used to show that the PSE observed at Roburent is generally generated at distances between 12 and 27 Earth radii, i.e., chiefly on the night side of the Earth. (BBB)

46235 STUDY OF THE E_S LAYER AT MIDDLE LATITUDES BY THE METHOD OF VHF FORWARD SCATTERING. Tridzskova, L.; Samardziev, D. T. (Geophysical Inst., Czechoslovak Academy of Sciences. Geophysical Inst., Bulgarian Academy of Sciences). Geomagn. Aeronomy (USSR) (Engl. Transl.). 7: 83-6 (1967).

Translated from Geomagn. Aeronomiya, 7: 110-15(1967).

Data on the appearance and duration of E_S clouds were obtained from observations on the forward scattering path of a continuous carrier wave with a frequency of 40.5 MHz. The diurnal and annual distributions of the appearance and duration of reflections from the E_S, the diurnal and annual patterns of the relative duration of the reflected signal, the diurnal distribution of the beginnings of long layers, and the distribution of the duration of individual reflections are found. (auth)

46236 OBSERVATIONS OF ULTRALOW FREQUENCY RADIATION AT CONJUGATE POINTS. Kleymenova, N. G.; Troitskaya, V. A.; Gendrin, R.; Vigneron, J.; Ponsot, C.; Dassac, M. (Inst. of Terrestrial Physics, Academy of Sciences, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 96-100(1967).

Translated from Geomagn. Aeronomiya, 7: 128-33(1967).

A comparison is made of ulf emissions in the 1.5- to 3-kHz band at the conjugate points Sogra and Kerguelen. The results of a statistical analysis of observations over a year are reported, such as diurnal variations, the average duration of ulf bursts, and the relation of ulf emission to magnetic activity, ionospheric disturbances, and earth current variations. (auth)

46237 SEMIANNUAL VARIATION OF MAGNETIC ACTIVITY. Mishina, N. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 104-8(1967).

Translated from Geomagn. Aeronomiya, 7: 138-43(1967).

The conclusion is derived from an analysis of data for several years that semiannual magnetic activity variations are caused by three mechanisms producing activity maxima near the instants of maximum and minimum heliographic latitude of the earth. An analogy is found between semiannual magnetic activity variations and the density variations of the upper atmosphere. It is found that currents of local (middle-latitude) origin contribute to magnetic disturbances at middle latitudes. (auth)

46238 GEOMAGNETIC MICROPULSATIONS AND THE SOLAR WIND. Moskvin, Yu. L.; Frank-Kamenetskii, D. A. (Moscow Physical-Technical Inst.). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 109-12(1967).

Translated from Geomagn. Aeronomiya, 7: 144-8(1967).

The possible mechanisms of excitation of geomagnetic field micropulsations by the solar wind flowing around the magnetosphere are analyzed. The first stage is the excitation of surface waves as a result of the instability of the tangential discontinuity. Waves that propagate from the surface toward the volume and are detectable on earth can originate from two resonance mechanisms of transformation: linear interaction of surface with Alfvén waves propagating along lines of force and a nonlinear mechanism with a doubling of frequencies. (auth)

46239 CYCLIC FLUCTUATIONS OF SECULAR GEOMAGNETIC FIELD VARIATIONS AT TBILISI. Nodia, M. Z.; Katsiashvili, N. A.; Khvedelidze, N. S. (Inst. of Geophysics, Tbilisi, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 113-17(1967).

Translated from Geomagn. Aeronomiya, 7: 149-55(1967).

The secular variations of geomagnetic elements are studied from the data of Tbilisi observatory for 1879–1961. The main time-dependent change of secular variations of each magnetic element is parabolic on the average. The deviations of the observed secular variations from the corresponding parabolas have the form of circular fluctuations; the latter are compared with the corresponding curves of solar activity cycles. (auth)

46240 AURORAS DURING A PERIOD OF MINIMUM SOLAR ACTIVITY. Fel'dshteyn, Ya. I.; Lukina, L. V.; Shevnina, N. F. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 136-7(1967).

Translated from Geomagn. Aeronomiya, 7: 177-8(1967).

Photographic auroral observations of the IQSY program made it possible to obtain homogeneous data on the frequency of appearance and other characteristics of auroras in years of minimum solar activity. From observations covering two winter seasons, 1963–1964 and 1964–1965, data are plotted that show the latitudinal distribution of auroral frequency in the Northern Hemisphere for a 6-hour period, centered on local midnight on all days. Results are included of computations of the latitudinal auroral drift as a function of time, and variations of azimuths of extended auroral forms are considered. (J.H.M.)

46241 STRUCTURE OF THE DIURNAL AURORAL ACTIVITY PATTERN AT TIXIE BAY. Naudubovich, Yu. A. (Inst. of Cosmophysical Investigations and Aeronomy, Academy of Sciences, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 138-40(1967).

Translated from Geomagn. Aeronomiya, 7: 179-80(1967).

The results of an analysis of the all-sky electrophotometer records at Tixie Bay from 1959 through 1966 are reported. The data indicate that auroras have a tendency to appear in the same hours, not only on several successive nights, but over a period of several years. It is also shown that their character of development is related to time of appearance. (J.H.M.)

46242 VERTICAL ELECTRON-ION GAS DISTRIBUTION WITH WEAK DIFFUSION FLUX SOURCES. Polyakov, V. M. (Irkutsk State Univ., USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 142-4(1967).

Translated from Geomagn. Aeronomiya, 7: 183-5(1967).

Numerical expressions are presented for determining vertical electron–ion gas distribution with weak diffusion flux sources. The following conclusions can be derived from the computation: (1) a vertical distribution of the electron-ion gas concentration is established in the atmosphere under the effect of the central gravity field when the diffusion flux is stationary; (2) the level of the photochemical equilibrium and of zero diffusion is located below the layer maximum because of the effect of intense electron–ion gas sources; and (3) there are two levels in the F region of the ionosphere in the vicinity of which electron density maxima may form. (J.H.M.)

46243 VERTICALLY MOVING DISTURBANCES IN THE NIGHTTIME IONOSPHERE. Sharadze, Z. S.; Kvavadze, D. K. (Tbilisi State Univ., USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 144-7(1967).

Translated from Geomagn. Aeronomiya, 7: 186-9(1967).

An analysis is made of vertical ionospheric sounding data at Tbilisi in November 1962 and January 1964–April 1966, as well as the results of continuous records of the appearance and development of vertically moving disturbances (VMD). Special consideration is given to the types of VMD observed. (J.H.M.)

46244 VARIATIONS OF THE CUTOFF FREQUENCIES OF THE SPORADIC E LAYER. Starovatov, A. A. (Academy of Sciences, Alma-Ata, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 149-50(1967).

Translated from Geomagn. Aeronomiya, 7: 192(1967).

Data from Alma-Ata on the sporadic E_s layer from April through September 1964 were used to analyze the variations of the cutoff frequencies of the E_s layer as a function of the lunar phase. The time variations of cutoff frequencies are compared with cosmic-ray intensity. (J.H.M.)

46245 INFLUENCE OF THE STATISTICAL PROPERTIES OF THE IONOSPHERE ON RADIO WAVE ABSORPTION MEASUREMENTS. Gorshkova, V. E. (Polar Geophysical Inst., Academy of Sciences, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 152-4(1967).

Translated from Geomagn. Aeronomiya, 7: 194-6(1967).

A distribution curve of the envelope of the amplitudes of reflected signals is used to study the fading of reflected signals. A number of cases most suitable for the analysis of reflections from the E_s were analyzed and cases of reflections from the F2 were selected at random for comparison. Data show a nearly linear relationship between integral radio-wave absorption and the cutoff E_s frequencies. The variation of ionization density is apparently of decisive importance in the increase of integral absorption associated with an increase of f_0E_s. (J.H.M.)

46246 RELATIONSHIP BETWEEN PP AND VARIATIONS OF AURORAL LUMINESCENCE. Bakhur, L. V.; Lyatskii, V. B.; Selivanov, V. P. (Leningrad State Univ.). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 164-6(1967).

Translated from Geomagn. Aeronomiya, 7: 208-9(1967).

Variations of auroral luminescence and of the geomagnetic field were recorded synchronously at Lovozero Station in the springs of 1964 and 1965. Due to an interest in pulsations of the pearl-type (PP), magnetic field pulsations with periods exceeding 5 sec and less than 0.5 sec were filtered when possible. Analyses of a number of the records indicate the following: (1) surges of auroral luminescence are always accompanied by an irregular PP (PPi) burst; (2) in two cases, series of PP with a sudden commencement began simultaneously with auroral luminescence surges; (3) PP with a gradual commencement are rarely observed during auroras; (4) an auroral luminescence surge frequently exhibits low-amplitude pulsations with a frequency close to that of a simultaneous PPi; and (5) rapid pulsations with a frequency of ~10 Hz appear in auroras during a polar disturbance. (J.H.M.)

46247 COMPARISON OF THE COMPUTED GEOMAGNETIC FIELD WITH THAT MEASURED ON THE COSMOS-49 SATELLITE. Adam, N. V.; Ben'kova, N. P.; Portnova, V. P.; Tyurmina, L. O. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 166-8(1967).

Translated from Geomagn. Aeronomiya, 7: 210(1967).

A magnetic survey was carried out at altitudes of 260 to 490 km by the Cosmos-49 satellite in the latitude interval ±50°. The absolute value of the field intensity, T, was measured. The distance between points of measurement along the flight trajectory was ~300 km. A total of 18,000 measurements was obtained. The measured field, T_{meas}, is compared with the field computed from spherical harmonic coefficients from the 1960 analysis of data reported by Adam, Osipov, Tyurmina, and Shlyakhtina. The spatial patterns of the difference $\Delta T = T_{meas} - T_{comp}$ are examined. (J.H.M.)

46248 INTERPRETATION OF THE DURATION OF SUDDEN COMMENCEMENTS OF MAGNETIC STORMS OBSERVED ON ELEKTRON 2. Ivanov, K. G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 4-6(1967).

Translated from Geomagn. Aeronomiya, 7: 7-10(1967).

An earlier scheme of the increase of the field during sudden commencements of magnetic storms in the magnetosphere is refined. This is achieved by constructing and using a more accurate vertical velocity profile of hydromagnetic waves and by using data from direct observations of the extension of that part of the magnetosphere boundary that is subject to the effect of the dynamic pressure of the solar wind. The scheme is used for an approximate estimate of the duration of sudden commencements at geocentric distances of ~10 R. The duration obtained (12 to 35 min) agrees with the results of observations on the Elektron-2 satellite (15 to 20 min). It is assumed that the influence of secondary phenomena taking place in the ionosphere and in the upper conductive layers of the earth is responsible for the shorter duration of sudden commencements at the Earth's surface (3 to 6 min). (auth)

46249 INSTABILITY OF THE DISTURBED ZONE IN THE VICINITY OF A BODY IN PLASMA IN THE PRESENCE OF ELECTRON EMISSION FROM ITS SURFACE. Smirnova, V. V. Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 25-34(1967).

Translated from Geomagn. Aeronomiya, 7: 33-44(1967).

The stability is analyzed of the disturbed zone in the vicinity of a body in an equilibrium plasma in the presence of electron emission from its surface. Thermal emission and photoemission are examined. Numerical stability criteria are obtained. It is shown that when a hot probe is used, instability can be expected only if the probe is made of materials that produce a high thermal emission flux. It is also shown that upon reentry into the atmosphere instability associated with thermal emission is unlikely and that in the presence of photoemission, associated with solar radiation, the disturbed zone must be stable. (auth)

46250 SOUND PROPAGATION IN A PARTLY IONIZED PLASMA. Veselovskii, I. I. (Moscow Physical-Technical Inst.). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 35-42(1967).

Translated from Geomagn. Aeronomiya, 7: 45-54(1967).

The propagation of sound fluctuations in a partly ionized plasma is analyzed for the case when wavelength is much greater than the mean free path of charged particles, but smaller than the mean free path of neutral particles. The kinetic coefficients of this plasma are computed. A simple collision model, permitting in the end computation of quadratures, is examined and used to estimate the quantities obtained. (auth)

46251 CORRELATION BETWEEN IRREGULAR PHENOMENA IN THE IONOSPHERE OF THE AURORAL ZONE AND DISTURBANCES IN THE OUTER RADIATION BELT. Gorbushina, G. N.; Kuznetsov, S. N. (Moscow State Univ.). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 43-7(1967).

Translated from Geomagn. Aeronomiya, 7: 55-61(1967).

The geographic location of the zone of irregular phenomena in the lower ionosphere is compared with the outer radiation belt. It is found that the location of this zone coincides with the position of the high-latitude boundary of the outer radiation belt. The shift of the zone of ionospheric disturbances to lower latitudes during magnetic disturbances coincides with the shift of the radiation belt boundary. The spatial and temporal characteristics of electrons fluxes precipitating from the belt coincide with the spatial and temporal characteristics of irregular phenomena in the lower ionosphere of the auroral zone. (auth)

46252 CHANGE IN THE BOUNDARIES OF THE OVAL AURORAL ZONE. Starkov, G. V.; Fel'dshteyn, Ya. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 48-54(1967).

Translated from Geomagn. Aeronomiya, 7: 62-71(1967).

The position of the northern and southern boundaries of the latitude interval where auroras appear on the day and night sides of the earth is examined as a function of the intensity of magnetic disturbance. The variations of parameters characterizing the position of the oval zone are determined as a function of the Q index of activity. A schematic representation of the auroral belt is presented for magnetic disturbances with a Q index of 0, 1, 4, and 7. (auth)

46253 ORIENTATION OF EXTENDED AURORAL FORMS. Starkov, G. V.; Fel'dshteyn, Ya. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 55-8(1967).

Translated from Geomagn. Aeronomiya, 7: 72-7(1967).

The diurnal pattern of the azimuths of arcs at Cape Chelyuskin and Piramida stations is determined. It is shown that there is no jump of azimuths in the morning hours. The auroral zone is constructed in coordinates of geomagnetic time and corrected geomagnetic latitude on the basis of data on the orientation of extended forms at various latitudes. (auth)

46254 AURORAL FREQUENCY AT MURMANSK IN YEARS OF MAXIMUM AND MINIMUM SOLAR ACTIVITY. Mal'ko, L. N. (Polar Geophysical Inst., Academy of Sciences, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 59-61(1967).

Translated from Geomagn. Aeronomiya, 7: 78-82(1967).

The results of auroral studies at Murmansk during the IGY and the IQSY are compared. Auroral frequency is compared with K indices. It is found that in the winter of 1963–1964 the auroral belt shifted to high latitudes and auroral frequency decreased. At latitudes to the south of the auroral zone, auroral probability is lower and the southern boundary is closer to the pole in a period of low solar activity than in a period of high activity for the same K indices. (auth)

46255 ION COMPOSITION AND VARIATIONS OF THE EFFECTIVE RECOMBINATION COEFFICIENT IN THE IONOSPHERE. Ivanov-Kholodnyi, G. S. (Academy of Sciences, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 62-70(1967).

Translated from Geomagn. Aeronomiya, 7: 83-94(1967).

The dissociative recombination rates of O_2^+, NO^+, and N_2^+ ions are examined on the basis of laboratory and ionospheric data. The variations of the effective recombination coefficient, α', of the ionosphere at heights of 100 to 200 km are analyzed as a function of height, time of day, and solar activity level with allowance for available temperature and ion composition data. The quantity α' varies in the E and F1 regions of the ionosphere. It is found that α' is higher in the morning than in the daytime in the F1 layer, particularly during low solar activity, while it increases in the daytime in the E region during high solar activity. (auth)

46256 VERTICALLY MOVING DISTURBANCES AND THE STRUCTURE OF THE IONOSPHERE. Sharadze, A. S.; Kvavadze, D. K. (Tbilisi State Univ., USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 71-4(1967).

Translated from Geomagn. Aeronomiya, 7: 95-9(1967).

Vertically moving disturbances in the ionosphere are described from observations at Tbilisi. Three types of disturbances, A1, A2, and A3, producing various changes in the ionosphere, are considered. Changes in the F region begin prior to the appearance of type A1 and A2 disturbances. It is shown that the Z component in the F region is the result of vertically moving disturbances. (auth)

46257 CAUSES OF TWO TYPES OF ANOMALOUS ABSORPTION IN THE POLAR CAP. Khocholava, G. M. (Inst. of Geophysics, Tbilisi, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 75-7(1967).

Translated from Geomagn. Aeronomiya, 7: 100-3(1967).

Factors responsible for the separation of anomalous polar cap absorption into two types are analyzed. It is shown that the solar longitude of a flare responsible for anomalous absorption and the state of the interplanetary magnetic field play some role in this separation. (auth)

46258 DISTURBANCE OF THE LOWER IONOSPHERE BY A RADIO PULSE. Ginzburg, E. I. (Novosibirsk Electrical Engineering Inst., USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 7: 78-82(1967).

Translated from Geomagn. Aeronomiya, 7: 104-9(1967).

Expressions are obtained for estimating the variations of electron concentration, $\Delta N/N_0$, in the lower ionosphere as a result of the temperature dependence of the effective recombination coefficient when a transmitter operates in a pulse mode. It is shown that these variations amount to fractions of a percent. The dependence of the characteristic time of establishment of electron temperature Te on wave power is given. The possibility is indicated of determining the δ and ν_0 parameters in the lower ionosphere experimentally in the case the pulse power changes. (auth)

46259 THE INTERPRETATION OF RECENTLY-MEASURED PROPAGATION CONSTANTS FOR AUDIO-FREQUENCY ELECTROMAGNETIC WAVES IN TERMS OF MODEL IONOSPHERE PROFILES. Challinor, R. A. (King's Coll., London). J. Atmos. Terrest. Phys., 29: 995-1003(Aug. 1967).

Results of a recent measurement, at a period of minimum solar activity of the phase velocity and attenuation of electromagnetic waves in the frequency range 40 cps to 10 kc/s are used, in conjunction with waveguide mode theory of propagation for the Earth-ionosphere duct, to derive theoretical daytime and nighttime electron density profiles in the lower ionosphere. A perfectly conducting Earth is assumed, and a simple correction applied to take account of the vertical geomagnetic field. Good agreement is obtained between the experimental attenuation and phase velocity curves and those predicted for the ionosphere models. The daytime models show lower electron densities than a number of measured profiles, probably because of the low solar activity at the particular period of the observations. (auth) (UK)

46260 DETERMINATION OF LOSS AND TRANSPORT IN THE NIGHTTIME F REGION FROM BACKSCATTER N–h PROFILES. Prasad, S. S. (Arecibo Ionospheric Observatory, Puerto Rico). J. Atmos. Terrest. Phys., 29: 987-93(Aug. 1967).

A method for the determination of the attachment coefficient and total vertical transport velocity in the nighttime F region is presented. This needs integration of dn/dt and loss-term only between levels of equal electron densities, and an assumption that in a normal nighttime F region, the total vertical transport velocity, v, can be expanded as $v = v_0 + a(h - h_0) + b(h - h_0)^2$ with $b \ll a$ and h_0 as some reference height (300 km, say). Use of dn/dh — a quantity difficult to determine accurately — is avoided in this method. The preliminary results appear to be reliable. (auth) (UK)

46261 INTENSE NEGATIVE BAYS INSIDE THE AURORAL ZONE. I. THE EVENING SECTOR. Akasofu, S.-I.; Meng, C.-I. (Univ. of Alaska, College). J. Atmos. Terrest. Phys., 29: 965-73(Aug. 1967).

Intense negative bays which occur well inside the auroral zone in the early evening hours are examined. As suggested by Akasofu, Chapman and Meng (1965), they can be explained by the westward extension of the polar electrojet which follows the traveling auroral surge along the auroral oval. It is shown that the polar electrojet flowing westward along the auroral oval is in accord with the results of two different kinds of analyses of polar geomagnetic disturbance, namely the "SD analysis" and the "spiral analysis." (auth) (UK)

46262 ON THE IONOSPHERIC F2 REGION EQUATORIAL ANOMALY AND THE GEOMAGNETIC FIELD. Ostrow, S. M.; Stewart, F. G. (Inst. for Telecommunication Sciences and Aeronomy, Boulder, Colo.). J. Atmos. Terrest. Phys., 29: 1005-10(Aug. 1967).

Exception is taken to Awojobi's [ibid. 27: 1309(1965)] conclusion that the equatorial anomaly in the latitude variation of monthly me-

dian noon f_0F2 is not associated with the geomagnetic field. Results from recent work on numerical mapping of f_0F2 are presented that confirm the dependence of the equatorial anomaly on the geomagnetic field. (auth) (UK)

46263 ABNORMALLY EARLY APPEARANCE OF THE EASTWARD MOTION OF AURORAS IN THE EVENING. Akasofu, S.-I.; Meng, C.-I. (Univ. of Alaska, College). J. Atmos. Terrest. Phys., 29: 1029-31(Aug. 1967).

It is shown that in the early evening sky the eastward drifting Ω band appears behind the westward traveling surge. The associated motion of the magnetospheric plasma is discussed. (auth) (UK)

46264 AURORAL ACTIVITY IN THE EVENING SECTOR. Akasofu, S.-I.; Meng, C.-I. (Univ. of Alaska, College). J. Atmos. Terrest. Phys., 29: 1015-18(Aug. 1967).

It is shown that the auroral zone is not the central region of auroral activity in the early evening sector. Intense evening auroral activity, characterized by westward traveling surges, occurs along the auroral oval which is almost out of the field of view of typical auroral zone stations, like College and Macquarie Island. (auth) (UK)

46265 THE CONJUGACY OF F-REGION PERTURBATIONS. Cummack, C. H. (Dept. of Scientific and Industrial Research, Christchurch, New Zealand). J. Atmos. Terrest. Phys., 29: 811-18(July 1967).

It is shown that electron density perturbations in the ionospheric F region can be transmitted to the magnetically conjugate region. It is also shown that the mechanism of coupling is probably electrostatic. Two types of perturbation are evident; stationary and moving patches. The moving patches have been tentatively identified with large scale "Munro" travelling ionospheric disturbances. (auth) (UK)

46266 PATTERNS OF MAGNETOSPHERIC ELECTRON PRECIPITATION. Catchpoole, J. R. (Univ. of Queensland, Brisbane). J. Atmos. Terrest. Phys., 29: 819-27(July 1967).

Using an idealized magnetospheric–ionospheric circuit between conjugate points, a determination has been made of the relative worldwide precipitation of magnetospheric electrons into the lower, denser atmosphere. The precipitation considered is that due to the superposition of a longitudinal electric field along the direction of the magnetic field lines. The patterns so found are an appropriate transformation of the controlling ionospheric wind velocity distribution used, suitably modified in accordance with the electric characteristics of the magnetospheric and ionospheric paths. Patterns are presented for the precipitation of electrons of various energies; an indication of the temporal variation of one of these is given. (auth) (UK)

46267 ORIENTATION OF AURORA AND THE CONCURRENT MAGNETIC DISTRUBANCE. Kim, J. S.; Wang, C. S. (Univ. of Idaho, Moscow). J. Atmos. Terrest. Phys., 29: 829-37(July 1967).

Orientations of auroral arcs were determined from all-sky photographs taken at Flin Flon (54.8°N, 101.8°W), Canada during 1958. The corresponding magnetograms were also examined in an attempt to verify the theory that intense ionospheric currents flow along the auroral arc during the auroral display. The average value for the orientation of auroral arcs was found to be 98.4°. Significant diurnal and seasonal variations of orientation were observed. The average value for the angle between the auroral arc and the horizontal component of the concurrent magnetic disturbance was 89.8°, indicating that the theory is substantially correct. (auth) (UK)

46268 IONOSPHERIC ION–MOLECULE REACTION RATES. Ferguson, Eldon E. (Inst. for Telecommunication Sciences and Aeronomy, Boulder, Colo.). Rev. Geophys., 5: 305-27(Aug. 1967).

The current status of laboratory measurements of ion–molecule reactions of ionospheric relevance is reviewed. Rate constants for the atmospheric loss reactions of He^+, O^+, and N_2^+ appear to be established to within about a factor of 2 at 300°K. The laboratory rate constants for O^+ and N_2^+ ion loss are compatible with quiet midlatitude E- and F-region requirements. The He^+ loss reactions appear to be higher than is compatible with some He^+ concentrations observed; however, the laboratory rate constants have been measured by so many investigators that they are unlikely to be seriously in error. In the D region, on the other hand, many of the important reactions are as yet unmeasured. Measurements of the relevant negative ion reactions with neutrals have only recently been started. No in situ atmospheric negative ion composition studies have as yet been carried out to guide the laboratory investigations. Many positive ion reactions of importance in the D region (as well as in sporadic E layers) remain to be measured. Finally, very little information concerning reactions of excited state ions with neutrals has been obtained. This will be important for certain disturbed ionospheric conditions and possibly for a precise analysis of normal ionospheric conditions, when this is merited. (auth)

46269 AURORAL PROTON PRECIPITATION AND HYDROGEN EMISSIONS. Eather, R. H. (Rice Univ., Houston, Tex.). Rev. Geophys., 5: 207-85(Aug. 1967).

Protons in the one to hundreds of keV energy range precipitate into the atmosphere in the auroral zone. Limited rocket and satellite measurements suggest total nighttime fluxes of the order of 10^7 cm^{-2} sec^{-1} $sterad^{-1}$ for energies ≥10 keV, with about 1% of this flux above 100 keV, and perhaps 10^{-3}% above 500 keV, as being reasonable but not necessarily average. The proton flux below 10 keV may exceed the flux above 10 keV by as much as a factor of 10 or even 100. Daytime fluxes appear to be less than nighttime fluxes. Various pitch-angle distributions have been reported, and there is some suggestion that the proton flux at high pitch angles increases with decreasing proton energies. The region of precipitation is normally a broad (3 to 7° of latitude) diffuse zone that locates on the equatorward side of the region of electron precipitation. Protons undergo charge-exchange interactions in the atmosphere, forming neutral hydrogen atoms in excited states in sufficient quantity to give readily detectable Balmer series emissions (Hα, Hβ, and Hγ) on the ground. The Hβ intensity is typically less than 100 R, and the Balmer decrement Hα/Hβ is about 3. This proton precipitation also results in the excitation of various oxygen and nitrogen emission, such as λ3914, λ4709 N_2^+, and λ5577 O I, and theoretical ratios of the intensities of these emissions to the Hβ intensity in an aurora excited entirely by protons are 5 to 20, 0.3 to 1.0, and 4 to 12, respectively. Strong visual auroras cannot be excited entirely by protons. The Balmer emissions are radiated by moving hydrogen atoms, and thus the radiation is Doppler-shifted. The magnetic-zenith profile commonly shows about a 6-A Doppler shift of the profile peak, whereas the magnetic-horizon profile is unshifted; the proton pitch-angle distribution results in a Doppler broadening of both profiles. The shape of the hydrogen line profiles reflects the energy and pitch-angle distributions of the incident protons, as well as the energy dependence of the charge-exchange cross sections involved. Theoretical interpretation of measured line profiles in terms of simplified models of proton precipitation has led to dubious conclusions. There is little or no dependence of the occurrence of hydrogen auroras on the presence of stronger, visual (electron-excited) auroras, though visual auroras may frequently be superimposed on the broader, diffuse zone of hydrogen emission. There is little evidence for rapid variations in hydrogen intensities similar to the pulsations often observed in electron-excited emissions, though longer period (~minutes) variations have been reported. The zone of hydrogen emission locates equatorward of quiet visual arcs and moves to lower latitudes before midnight and back poleward again after midnight, and it often expands poleward in association with auroral breakup events. The zone appears to widen and move equatorward during increased magnetic activity. Other effects of proton precipitation include "r" type E, ionization and possibly certain types of radio auroras. Polar-glow auroras are associated with higher-energy proton events (though the main excitation could be due to lower-energy particles). Low-energy proton precipitation may cause appreciable heating of the upper atmosphere and may excite certain high-altitude red arcs at both midlatitudes and high latitudes. Auroral protons may also represent a significant source of neutral hydrogen at auroral latitudes. (auth)

46270 OCCURRENCE OF SUDDEN COMMENCEMENTS IN CONNECTION WITH SOLAR ACTIVITY. Schroeder, Wilfried (Geophysical Station, Bremen-Roennebeck, Ger.). Beitr. Geophys., 75: 231-6(1966). (In German).

The relations between 27 sudden commencements, solar activity, and geomagnetic conditions during 1963 and 1964 are examined. A small Kp index (<4) is associated with 15 sudden commencements. The relation to larger solar eruptions can be demonstrated only in a few cases. The results are compared with the relations between the solar wind and its influence on the magnetosphere. The source of the energy is suggested to be stored in the magnetosphere itself before it appears in the production of sudden commencements. The magnetohydrodynamic waves responsible for conversion of energy in the solar wind to the Earth's magnetic field arise particularly at surfaces which the solar wind can penetrate without reflection. The source of these waves may be sought in surface instabilities, which can occur without increased solar additions. (BBB)

46271 THE DEVELOPMENT OF THE AURORA OF OCTOBER 6, 1960. Schroeder, Wilfried (Geophysical Station, Bremen-Roennebeck, Ger.). Beitr. Geophys., 75: 237-40(1966). (In German).

The aurora of October 6, 1960, is examined in connection with solar and geomagnetic activity. The Kp indexes for October 6 and 7 exceeded 7; the Q indexes of 8, 9, and T were reported 44 times.

These intense geomagnetic variations were noted without sudden commencements; correlations with solar phenomena are not clear. Isolated reports of form C occur, but generally R, G, and S forms (and additionally DS and RB) were observed. Brightness in the south was class 1; other reports list IBC = 2, 3, and 4. The color was red, signaling maximum geomagnetic disturbances. This was followed in the northern hemisphere to about 49°N. An explanation possibly lies in the surface regions of the magnetosphere, with a great role played by the outer Van Allen Belt, which is known to react very sensitively to slight disturbances. (BBB)

46272 CHARACTERISTICS AND WORLDWIDE PROPAGATION OF Pi 2 MICROPULSATIONS. Rostoker, Gordon. Vancouver, B. C., Univ. of British Columbia, 1966.

Thesis.

To study the propagation characteristics of Pi 2 micropulsations, a set of five fluxgate magnetometer units was set up stretching across the continent from Victoria, B.C. to Montreal, P.Q. with all stations lying on approximately geomagnetic latitude 56°N. Continuous recordings of H, D and a filtered H component (bandpass 25 to 200 sec.) were made from June 1, 1965, to Aug. 15, 1965. Further information on pertinent disturbances was obtained from stations distributed over the continents of North America and Antarctica. A theoretical study of some of the possible modes of propagation was carried out and specific characteristics of each mode were established in order to permit a check with the experimental data obtained. The pulsations of interest were digitized and power spectra as well as Fourier spectra were computed for the H and D components. The position in longitude of the source of the disturbance was determined making use of pulsation amplitudes, bay amplitudes, and the direction of the disturbance vectors in the horizontal plane. An intensive investigation of the polarization of the pulsations in the horizontal plane was carried out, making use of the complete chain of several cycles but drawing each cycle separately for comparison purposes. This analysis disagrees with previous claims that Pi 2 pulsations are polarized anticlockwise after local midnight and clockwise before local midnight. On the basis of the analysis performed with the data, it was found that the mode of propagation most likely responsible for the transfer of Pi 2 activity from high to mid latitudes could be described by a plane electromagnetic wave propagating approximately normal to the Earth's magnetic field lines through the lower E region of the ionosphere. It is found that the maximum period in a Pi 2 event increases with increasing K_p index in the range $K_p \sim 0 + 2o$. This complements the earlier observation that the dominant period in a Pi 2 event decreases as the K_p index increases; this fact is also verified in the analysis of the experimental data. It is found that the number of peaks in the frequency spectrum of a Pi 2 event increases approximately linearly with increasing K_p. (Disser. Abstr.)

46273 OBSERVATIONS OF WHISTLER-MODE SIGNALS IN THE OGO SATELLITES FROM VLF GROUND STATION TRANSMITTERS. Heyborne, Robert Linford. Stanford, Calif., Stanford Univ., 1967. 223p.

Thesis.

In the ionospheric plasma, electromagnetic propagation is possible at frequencies below the plasma frequency and the electron gyrofrequency. This mode of propagation is commonly known as the whistler mode. Amplitude calibrated receivers aboard two satellites (OGO-I and OGO-II) are used to receive signals propagating in the whistler mode from U. S. Navy vlf stations on the ground. Existing theory is utilized to calculate the expected intensities of these signals. Measured and calculated intensities are then compared. The two satellites effectively subdivide the whistler-mode path into two main parts: (1) the Earth–ionosphere waveguide loss, the boundary and excitation loss, and the absorption loss through the ionosphere to the altitudes of OGO-II, and (2) losses due to divergence of the signal between OGO-II and the higher altitudes of OGO-I plus any additional absorption above OGO-II. These data are utilized to determine more precisely the major features and loss characteristics of whistler-mode paths inferred from previous experiments, and to determine the accuracy of attenuation rates predicted earlier by theoretical means. It is concluded that the average intensity of vlf whistler-mode signals in the magnetosphere may usually be predicted to an accuracy of ±10 db by the use of available models and existing theory. This study strongly supports present understanding of the major features of whistler-mode propagation which until now has been based largely on theoretical developments and experimental observations of naturally occurring phenomena. Several new observations have been made. These include: (1) A Northern hemisphere latitudinal cutoff of vlf signals. Signal intensities have been observed to decrease as much as 40 db as OGO-II moves from approximately 59° to 60° Northern geomagnetic latitude. Signals are seldom observed at latitudes above the cutoff region. There is evidence that the cutoff is more pronounced during the daytime and when the geomagnetic planetary K_p index is high. It is hypothesized that the $N\nu$ product in the D and E regions of the ionosphere increases rapidly with latitude near the cutoff region. The evidence suggests that the observed cutoff is consistent with an absorption explanation. (2) Strong enhancements of vlf signals near the antipodes of vlf transmitters. Enhancement factors as high as 25 db have been observed when the satellite flies within 200 km of the antipode. Enhancements have also been observed near the magnetic conjugate of the antipode. (3) A pronounced dip in the intensity of vlf signals over the geomagnetic equator. Seen at all longitudes, both daytime and nighttime, the magnitude of the equatorial dip is typically 12 to 20 db during the daytime and 5 to 10 db during the nighttime. The observation is explained on the basis of absorption. (4) A band of intense noise at 18 kHz around both polar regions. The intense noise is observed in a band, 3 to 11 degrees wide, centered near 75 degrees geomagnetic latitude. Occurrence of the noise exhibits seasonal dependence with local summer rates higher than winter. Although there is evidence that the intense noise is more likely to be observed during magnetically disturbed periods, fluctuations in the noise magnitude cannot be explained by fluctuations in the K_p index. (Disser. Abstr.)

46274 VLF RAY TRACING IN A MODEL IONOSPHERE. Shawhan, Stanley Dean. Iowa City, Iowa, Univ. of Iowa, 1966. 186p.

Thesis.

A vlf ray tracing study in a model ionosphere including ions is presented. A review of previous vlf ray tracing methods is given. The physical meaning of rays and ray paths is discussed and it is concluded that for ray tracing in the ionosphere the wave packet and Poynting vector approaches give the same results. Two-dimensional ray tracing equations are derived for the case of a horizontally stratified ionosphere and the derivation of three-dimensional equations for the curved ionosphere is sketched. These ray-tracing equations are integrated for the special cases of exactly transverse and exactly longitudinal propagation, but it is concluded that neither case can persist for very-low-frequency radio waves in the ionosphere. Also the conditions for reversibility of a ray path are derived. It is found that the computer program for numerical integration of the ray-tracing equations can retrace a path to 0.3% in latitude and 0.02% in wave normal angle and can reproduce known results for the horizontally stratified model. Using this ray-tracing program the behavior of ray paths for variations of frequency, initial latitude, initial wave normal angle, initial altitude and ionospheric model are shown. The most important results were with variation of the initial wave normal angle; two ray paths for the same frequency can cross and rays can turn around at low altitude for frequencies less than the local lower hybrid resonance frequency. Spectrograms of proton, helium, and oxygen whistlers as well as negative ion whistlers are presented. It is predicted that oxygen whistlers can be observed at all altitudes below the oxygen gyrofrequency and that negative ion whistlers can be observed below 30 cps at altitudes near 300 km. Experimental data on the hook whistler, riser and check whistlers, "transverse" whistlers, and satellite observed vlf noise bands are presented and summarized. The hook whistler is explained as a multiple path whistler at equatorial latitudes for which the earlier trace has increased dispersion at low frequencies due to large wave normal angles along the path. This increased dispersion gives the characteristic joining of the two traces at low frequencies. A calculated hook whistler spectrogram is presented. The riser and check whistlers are explained as whistlers for which the ray has propagated transverse and nearly transverse to the magnetic field along its path. The point of transverse propagation produces the characteristic riser dispersion of increasing time delay with increasing frequency. For the check whistler apparently both the upgoing and downgoing rays are observed at the satellite giving a normal whistler dispersion followed by a riser-like tail. It is demonstrated that previous experimental data on the "transverse" whistler may have been misinterpreted and that the dispersion increases with decreasing frequency rather than decreases as previously reported. The transverse whistler is explained as a whistler which has acquired added dispersion at low frequencies because of propagation nearly transverse to the magnetic field along the path. Finally it is shown that waves can be trapped in the ionosphere between altitudes of decreasing transverse refractive index. It is proposed that these trapped waves can explain the satellite and ground observed ion gyrofrequency noise bands. (Disser. Abstr.)

46275 PHYSICS OF THE MOON. Proceedings of an AAS/AAAS Symposium Held at Washington, D. C., 29 December 1966. Singer, S. Fred (ed.). AAS Science and Technology

Series. Volume 13. A Supplement to Advances in the Astronautical Sciences. Washington, D. C., American Astronautical Society, 1967. 255p. (CONF-661215-(Vol.13).

Thirteen papers on various aspects of the moon such as origin, surface, gravity, emission, and seismic exploration are presented. Panel discussions are also included on the lunar surface and the lunar interior. (J.H.M.)

46276 SCIENTIFIC EXPERIMENTS FOR MANNED ORBITAL FLIGHT. Proceedings of the Third Goddard Memorial Symposium, 18–19 March 1965, Washington, D. C. Badgley, Peter C. (ed.). AAS Science and Technology Series. Volume 4. A Supplement to Advances in the Astronautical Sciences. Washington, D. C., American Astronautical Society, 1965. 371p. $14.25. (CONF-650331-(Vol.4)).

Seventeen papers on scientific experiments for manned orbital flights are presented. The papers give a well-rounded view of the great potential contribution to science by such flights. One address, "National and International Cooperation in Scientific Experiments on Future Earth-Orbital Spacecraft," is included. (J.H.M.)

Low-Temperature Physics

Refer also to abstract 45469.

46277 (FOA-4-4306-61) SUPRALEDNING VID RUMSTEMPERATUR. (Superconductivity at Room Temperature). Johansson, B. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). July 1967. 22p. (In Swedish). Dep.

The original research on superconductivity is summed up. The theory by Bardeen, Cooper, and Schrieffer is briefly described. Some applications of theories on superconductivity and the design of superconducting materials are discussed. The organic superconductor by Little, the surface superconductor by Ginsburg, and the Geilikman superconductor are mentioned. (Sweden)

46278 (N-67-19118) SUPERCONDUCTIVE PROPERTIES OF CERAMIC MIXED TITANATES. Schooley, J. F.; Frederikse, H. P. R.; Hosler, W. R.; Pfeiffer, E. R. (National Bureau of Standards, Washington, D. C.). [1966]. 22p. (NASA-CR-82657). CFSTI.

The superconducting transition temperature of a series of mixed barium–strontium and calcium–strontium titanate ceramic specimens have been determined. For several of these samples the low-field magnetization has also been investigated. The results are compared with those obtained from single-crystal $SrTiO_3$. (auth) (STAR)

46279 (SLAC-PUB-337) A 30-cm BORE 70-kG SUPERCONDUCTING HELMHOLTZ MAGNET. Brechna, H.; Haldemann, W. (Stanford Linear Accelerator Center, Calif.); McInturff, A. D. (Atomics International, Canoga Park, Calif.). Sept. 1967. Contract AT(04-3)-515. 32p. (CONF-670801-7). Dep. CFSTI.

From Cryogenic Engineering Conference, Palo Alto, Calif.

The design and performance of a 30-cm-bore, 70-kG-central-field supermagnet with an axial gap of 8 cm is described in detail. Preparatory work, such as choice of suitable hard superconductors and adequate substrates in combination with appropriate cooling, development of suitable insulations, current optimization, and the determination of size and number of modules in the coil, was necessary to venture in building a 5.2-MJ superconducting magnet. Studies on stability, field and force distribution, and field homogeneity are presented. Four coil modules have been operated several times and their cool-down, current charging characteristics, and operational performance are discussed. (auth)

46280 THERMAL CONDUCTIVITY AND THERMAL EFFECT IN SUPERCONDUCTING NIOBIUM. I. THERMAL CONDUCTIVITY. Umlauf, E. Z. Phys., 206: 415-30(1967). (In German).

The thermal conductivity in the mixed state of Nb is not only a function of the average energy gap. An extra scattering arising from the spatial modulation of the gap must be considered. The characteristic minimum of thermal conductivity is influenced by magnetic hysteresis. This effect is explained by Bean's model of flux penetration. The foregoing results run out from measurements of thermal conductivity and magnetization of several niobium samples in a longitudinal magnetic field. (auth)

46281 THERMAL CONDUCTIVITY AND THERMAL EFFECT IN SUPERCONDUCTING NIOBIUM. II. THERMAL EFFECT. Umlauf, E. Z. Phys., 206: 431-8(1967). (In German).

The "magnetothermal effects" described by Zebouni et al. are explained in a simple way. The temperature oscillations, occurring when magnetizing a Nb single crystal are caused by irreversible processes during the entrance of flux vortices into the sample. The irreversible Joule's heat as well as the reversible transition heat results in a thermal effect, which is characteristic for the sample and which can qualitatively change within a small temperature interval. (auth)

46282 COLLECTIVE TREATMENT OF LIQUID HELIUM. Bohm, D.; Salt, B. (London Univ.). Rev. Mod. Phys., 39: 894-910(Oct. 1967).

The problem of liquid helium is treated in terms of the theory of collective coordinates, applying a canonical transformation similar to that used previously for plasmas. This treatment provides further physical and mathematical insights into the origin of phonons, and into the nature of the roton excitations and their interactions. In particular, starting from the many-body Hamiltonian, it directly gives the Feynman–Cohen wave function, and the dipole–dipole interaction of rotons, along with certain further predictions with regard to the roton spectrum and the correlation function. The property of superfluidity is explained by the subsidiary conditions, which imply that individual particle excitations are impossible in the low-lying states of the system. The transformed Hamiltonian can thus be shown to have eigenfunctions corresponding to quantized vortices. (auth)

46283 MODULATION OF THE TUNNELING CURRENT BY SOUND WAVES IN A SUPERCONDUCTOR. Urushadze, G. I. (Inst. of Physics, Tbilisi, USSR). Sov. Phys.-Solid State (Engl. Transl.), 9: 1208-9(Nov. 1967).

Translated from Fiz. Tverd. Tela, 9: 1536-8(May 1967).

The tunneling current of a normal-metal–dielectric–superconductor structure in the case where sound waves pass through the structure is considered. The sound waves modulate the tunneling current at the corresponding frequency, and there is superimposed on the constant tunneling current a certain effective tunneling current that depends on the sound frequency. The volt–ampere characteristics of this effective current are studied theoretically as a function of frequency at absolute zero. (A.G.W.)

46284 SUPERCONDUCTING PROPERTIES OF VANADIUM–NIOBIUM ALLOYS. Sirota, N. N.; Ovseichuk, E. A. (Inst. of Physics of Solids and Semiconductors, Minsk). Dokl. Akad. Nauk SSSR, 174: 570-1(May 21, 1967). (In Russian).

An experimental investigation was made of changes in the critical parameters of V–Nb alloys resulting from modifications in composition. The measurements showed that, with increasing content of Nb, the critical temperature of the alloy reaches a minimum of 3.75°K at 30% Nb and 70% V. The measurements of critical currents and critical fields were made in the range of temperatures from 4.2 to 3.0°K. At constant temperatures, the j_{crit} and H_{crit} curves pass with increasing content of Nb through minima corresponding to the ratio 30% Nb–70% V. However, alloys rich in Nb (more than 30%), show at equal critical temperatures values of critical currents and critical fields substantially higher than the alloys with lower niobium content. It is noted that in the formation of V–Nb solid solutions there occurs a decrease of critical density of the current and of the field as well as of the critical temperature of the transition into the superconducting state. (ATD)

46285 ELECTRON TUNNELING IN SUPERCONDUCTORS. Urushadze, G. I. (Inst. of Physics, Tbilisi, USSR). Sov. Phys.-Solid State (Engl. Transl.), 9: 930-1(Oct. 1967).

Translated from Fiz. Tverd. Tela, 9: 1192-4(Apr. 1967).

Tunneling of electrons from a normal metal to a superconductor containing paramagnetic impurity atoms is considered. It is shown that the current–voltage characteristic of the tunnel current in such superconductors differs considerably at $T = 0$ from the characteristic of an ideal superconductor. The tunneling current at $T \neq 0$ is calculated. (auth)

46286 HARD SUPERCONDUCTORS. Dew-Hughes, David (Univ. of Lancaster, Eng.). Mater. Sci. Eng., 1: 2-29(May 1966).

The present state of knowledge and development of high-field superconductors is reviewed. Various theories proposed for these materials are critically examined, and it is concluded that high critical currents result directly from irreversible behavior of Abrikosov supercurrent vortices. Magnetization, critical currents, ac properties and flux instabilities are related to the pinning of vortices by structural inhomogeneities. The role of various types of defects in providing pinning is examined. Results are presented which show that only extended defects such as second-phase particles, nonhomogeneous distributions or tangles of dislocations, surface defects, and internal stress distributions have any appreciable interaction with supercurrent vortices. The behavior of commercial hard superconductors is explained in terms of these results. The application of hard superconductors for producing high magnetic fields in solenoids and flux pumps is discussed and the requirements of materials for these devices are indicated.

The commerical preparation of materials to meet these requirements is then reviewed. Some indication is given as to future developments which are desirable and which may be expected in both the science and practice of hard superconductors. (BBB)

46287 THEORY OF ELECTRON TUNNELING IN A SOUND FIELD IN SUPERCONDUCTORS. Urushadze, G. I. (Inst. of Physics, Tbilisi, USSR). Zh. Eksp. Teor. Fiz., 53: 1018-23 (Sept. 1967). (In Russian).

Tunneling of electrons through a structure consisting of a normal metal, dielectric and superconductor is considered for the case when a sound wave traverses the structure. The frequency dependence of the excess current produced by the sound field is found. (auth)

46288 THIRD CRITICAL FIELD OF A SUPERCONDUCTOR WITH A FILM ON THE SURFACE. Shmidt, V. V. (Inst. of Metallurgy, Moscow). Zh. Eksp. Teor. Fiz., 53: 936-42(Sept. 1967). (In Russian).

The third critical field is calculated for a system consisting of a thin superconducting film deposited on the plane surface of a massive superconductor. It is assumed that the film and backing differ only with respect to the electron mean free path. The two extreme cases of a thin and thick films are considered. A qualitative explanation of the experimental dependence of the third critical field of the superconductor on mechanical and thermal treatment of the surface is presented. (auth)

46289 HEAT EXCHANGE BETWEEN A SOLID BODY AND HELIUM FILLING A NARROW GAP. Adamenko, I. N.; Kaganov, M. I. (Physical-Technical Inst., Kharkov. Kharkov State Univ.). Zh. Eksp. Teor. Fiz., 53: 886-9(Sept. 1967). (In Russian).

The mechanism of heat exchange between a solid body and He II filling a narrow gap is considered. It is shown that the heat exchange significantly depends on the relation between the phonon mean free path l and the gap width d. The heat flux between the solid body and liquid helium below 1°K is calculated for $d \ll l$. (auth)

46290 SUPERFLUID HELIUM-THREE? Cohen, Roger Wolfe. New Brunswick, N. J., Rutgers-The State Univ., 1966. 124p.

The possibility of a transition in ^{3}He to a superfluid phase has been explored in a self consistent manner using the t matrix to describe multiple scattering between the particles. A model potential having the general features of the actual ^{3}He interparticle interaction (hard core plus attractive well) has been introduced in order to facilitate the calculations. The present work differs from previous ones by the inclusion of lifetime effects in the derivation of the effective pairing interaction at the Fermi surface. It is found that even a very small quasi-particle decay rate is sufficient to prevent a d-state condensation into a superfluid state. The experimentally observed decay rate is far above the minimum necessary to destroy superfluidity. This effect is a direct result of the proximity of the helium hard core to the attractive part of the potential. The effect of lifetimes for angular momentum states $l > 2$ is discussed. It is believed that a condensation probably exists for $l \geq 5$, possibly as low as $l = 4$. However, the transition temperatures associated with these states are so small ($<10^{-5}$°K) as to be beyond the limit of present day experimental techniques. These conclusions are supported by the fact that the model potential is capable of reproducing the observed quasi-particle decay rate only when lifetime effects are included. (Disser. Abstr.)

46291 SMALL ANGLE X-RAY SCATTERING BY LIQUID ^{3}He. Shah, Nareshchandra Premchand. Stanford, Calif., Stanford Univ., 1967. 91p.

Thesis.

A study was made of the velocity of high-frequency sound in ^{3}He by scattering x rays from the liquid and studying the temperature dependence of the scattering cross section at small angles. This study was undertaken to verify the prediction of L. D. Landau that sound waves, different in character from that of normal (hydrodynamic) sound, can be propagated in liquid ^{3}He when the wavelength of the sound wave is small compared to the mean free path between collisions of particles. Such a sound mode in liquid ^{3}He was named zero sound mode by Landau. A brief theoretical discussion of the scattering of x rays at small angles is presented. An apparatus constructed for this purpose is described in detail. The scattering amplitude from liquid ^{3}He in the temperature range 0.37°K to 1.6°K was measured at a scattering angle of 1.73°, which corresponds to a momentum transfer of one sixth of the Fermi momentum and a phonon frequency ω equal to 2.26×10^{11} radians per second. A total of 50 data points in the above temperature range are presented and analyzed. The analysis verifies the validity of the formula describing the scattering cross section at small scattering angles. The data at high temperature (≈0.8°K to 1.6°K) fit quite well to the hydrodynamic (adiabatic) velocity of sound. If the data are fitted by using the temperature dependent adiabatic velocity of sound, a marked deviation occurs at low temperatures between the observed and the computed values for the scattering. Assuming the above, described deviations are due to a transition from the normal sound mode and using them as a basis, a change in the value of the velocity of sound from that of the adiabatic velocity of sound was computed. The transition in the velocity of sound was found to occur at 0.51°K. The extrapolated value (189.4 ± 2 m/sec) of the velocity of sound agrees well with the value of zero sound velocity. The results are consistent with the prediction of Landau's theory of Fermi liquid and with the results of two reported lower frequency experiments concerning the zero sound mode in liquid ^{3}He. (Disser. Abstr.)

46292 NUCLEAR MAGNETIC SUSCEPTIBILITY AND SPIN DIFFUSION IN DILUTE SYSTEMS OF ^{3}He ATOMS. Opfer, James Edward. St. Louis, Washington Univ., 1966. 143p.

Thesis.

The spin-echo technique has been employed to measure the spin-diffusion coefficient and relative values of the nuclear magnetic susceptibility of ^{3}He in gaseous ^{3}He at temperatures from 1.1 to 4.2°K and in dilute solutions of ^{3}He in liquid ^{4}He (He II) at temperatures above 0.4°K. Results have been obtained for gas densities down to 2 amagats and for concentrations between 0.030% and 3.0% of ^{3}He in He II at pressures near the saturated vapor pressure. The results of measurements of the nuclear magnetic susceptibility of ^{3}He vapor at 2 and 3°K show that deviations from Curie's law are considerably smaller than those calculated for a perfect Fermi gas. An approximate theoretical expression, which relates deviations from Curie's law to the difference between the second virial coefficient of ^{3}He and the second virial coefficient calculated for a hypothetical ^{3}He with zero spin, accounts for the observed behavior of the susceptibility. Evaluation of the theoretical expression shows that temperatures lower than about 0.002°K are required for the applicability of the perfect-Fermi-gas theory in calculating the deviations from Curie's law that are of first order in the ^{3}He density. The experimental data for the spin-diffusion coefficient D_s in ^{3}He gas indicate that at constant temperature the product of D_s and the density is constant for densities less than 400 amagats. The quantity $D_s\rho$ increases with temperature approximately as T^4 for temperatures between 1.1 and 4.2°K. Measured values of D_s are compared with calculated values of the binary diffusion coefficient of a mixture of two distinguishable ^{3}He gases; differences between these quantities are small enough to be attributable to the uncertainty in the interatomic potential for ^{3}He atoms. The spin-diffusion data for the ^{3}He–He II solutions show that D_s increases with decreasing temperature for each ^{3}He concentration investigated. The dependence of D_s on ^{3}He concentration is accounted for by considering the first order approximation to the solution of a Boltzmann equation for a mixture of a roton gas and a gas of nondegenerate ^{3}He quasiparticles. Above 0.8°K the value of D_s in the limit of small ^{3}He concentration varies with the temperature T as $\exp(\Delta_r/k_BT)$ where Δ_r is the roton activation energy and k_B is the Boltzmann constant. The concentration dependent contribution to D_s varies nearly as 1/T throughout the temperature range investigated. The measured susceptibility of the ^{3}He–He II solutions exhibits a temperature dependence that is the same as that calculated for a perfect Fermi gas of particles whose mass is 2.6(±0.3) times the mass of ^{3}He atom, a range of values that includes the value of effective mass assigned to ^{3}He quasiparticles in the solution on the basis of other experimental data. It is shown that if the interaction between ^{3}He quasiparticles can be represented by a central potential whose range is approximately the same as the range of the interaction potential of helium atoms, then deviations from Curie's law in the ^{3}He–He II solutions are expected on the basis of the spin-diffusion data. (Disser. Abstr.)

46293 GYROSCOPIC DETECTION OF PERSISTENT FLOW OF SUPERFLUID HELIUM AND ASSOCIATED STUDIES. Mehl, James Bernard. Minneapolis, Univ. of Minnesota, 1966. 115p.

Thesis.

Persistent circulating currents of superfluid helium have been observed and studied by a gyroscopic technique. The liquid helium container was a thin glass sphere packed with a fine powder. Persistent superfluid flow was set up in the channels formed by the network of interstices of the packed powder. The circulating currents of superfluid were prepared both by (1) cooling the helium-filled sphere through the transition temperature in rotation, and (2) by rotating the sphere rapidly at a temperature below the transition temperature after cooling without rotation. Following both methods of preparation, the angular momentum of the persistent current that remained after stopping rotation of the sphere was measured by measuring the torque necessary to reorient the sphere. Other studies of superfluid flow in the powder-filled sphere were made using a variation of the classic Androni-

kashvilli pile-of-disks technique in which the oscillating pile of disks was replaced by the powder-filled sphere. The main results of the experimental work are: (1) Persistent currents of superfluid flow with a great deal of stability can exist. The angular momentum of such currents appears to be fixed in the helium container. (2) The currents have a lifetime longer than the theoretical lifetime of similar currents of liquid helium at temperatures above the transition temperature. (3) The persistent angular momentum is a reversible function of temperature as long as the temperature is not changed too rapidly. (4) When rotating liquid helium is cooled through the transition temperature, the superfluid is formed in a state with the angular momentum approximately equal to the solid body value. This result was verified only for sufficiently small angular velocities of preparation. (5) Critical velocity effects were observed when preparation of persistent currents was attempted at sufficiently high angular velocities. The observed critical velocities are in agreement with values observed in other experiments with superfluid flow channels of the same characteristic size. (TSS) (Disser. Abstr.)

46294 CRITICAL VELOCITY OF A SUPERFLOWING LIQUID HELIUM FILM USING THIRD SOUND. Pickar, Kenneth Arnold. Philadelphia, Univ. of Pennsylvania, 1966. 132p.

Thesis.

An investigation of the critical velocity of the helium film is made by impressing a third sound wave (surface ripple with Van der Waals restoring force) on a superflowing film. The velocities of the wave are measured traveling upstream and downstream. From these data, the superfluid critical velocity is deduced as $V_c = \frac{1}{2}(U_{3\,down} - U_{3up})$ where $U_{3\,down}$ is the third sound velocity traveling downstream and U_{3up} is the third sound velocity traveling upstream. The critical velocity at the lowest temperature (1.25°K) as a function of the film height is found to be close to $\hbar/2$ md where d is the film thickness. The critical velocity is measured as a function of temperature. There is an apparent decrease in the difference between the upstream and downstream third sound velocities as the temperature is raised. At about 2.0°K the two velocities become identical. This effect is not attributed to a large decrease in the critical velocity at the higher temperatures but rather as an effect of the chopper excitation of the third sound wave. The critical velocity as a function of the difference in reservoir heights is discussed. A crude determination of the transfer rate is made. Since the third sound wave is formed by the longitudinal oscillation of the superfluid component, the observation of the wave in a film flowing at the critical velocity indicates the possibility of film velocities in excess of V_c for measured times $T \sim 10$ msec where T is half a third sound period. This implies that there is a relaxation time τ for the extension of vortices where $\tau > T$. The velocity of a surface wave in bulk liquid helium .05 to 0.3 cm deep contained in a channel open at the ends is examined using a modified optical detection system. The results may be compared with a wave on a classical fluid with restoring forces of gravity and surface tension. (TSS) (Disser. Abstr.)

46295 INTERACTIONS BETWEEN MOLECULES AND SUPERCONDUCTORS Hoffman, Brian Mark. Pasadena, Calif., California Inst. of Tech., 1967. 142p.

Thesis.

Recently, the possibility has been raised that interactions favorable to superconductivity might occur in molecules. Although most molecules or molecular aggregates are not even potentially superconducting, the idea that molecules can be coupled to metals through various kinds of bonds, and that such systems may then have interesting superconducting properties was considered. The approach to the preparation of such systems involves the deposition of selected molecules on thin metal films. A discussion of the theory of superconductivity, including a review of some of the interaction mechanisms appropriate to molecules is presented. The experimental apparatus is described. The results are then reported and discussed. Compounds that increase the superconducting transition temperature and critical current of thin vanadium films as well as others that decrease them were found, and it was found that the sign of this effect can be correlated in a simple way with the electronic structure of the molecules. The nature of these effects is partially clarified by comparison to similar experiments with indium films. (Disser. Abstr.)

46296 RESIDUAL SUPERCONDUCTING RF LOSSES. Victor, Joe Mayer. Austin, Tex., Univ. of Texas, 1967. 122p.

Thesis.

Theoretical and experimental investigations are made into the residual rf losses at temperatures well below the critical value in superconductors. Pulse techniques are used to measure the superconducting circuit Q, yielding a direct indication of the surface losses. The experimental measurements are made in the frequency range from 60 to 350 MHz. at temperatures below 4.2°K in tin foil samples. The circuits were cooled in an external magnetic field. The measurements are also restricted to very low level rf fields. A review of the fundamental properties of superconductors is made to provide a background for the model presented. Also provided is a review of various surface resistance models that dominate the residual losses at higher frequencies and lower external magnetic fields. In addition, a review of two models previously proposed to explain residual losses is presented. Flux trapped during the cooling process is proposed as the rf loss mechanism. This model is similar to, but more complete than, one presented by Pierce, Schwettman, Fairbank, and Wilson. A simple model based on ohmic losses in the normal regions caused by trapped flux gives a residual resistance that depends upon the cooling field and the condition of the sample. The temperature dependence of this loss is that of the volume of the sample through which rf current flows. Experimental data are shown which support the dependences predicted in the trapped flux model. Results of tests by Haden and Pierce, et al., are also shown to fit this model, whereas this experimental data will not fit their models. Although these tests were done only on pure tin, the model should be applicable to superconductors in general. Temperature measurements for various cooling fields agree with the temperature dependence of the predicted losses and the linear dependence of the losses on the external magnetic field. The loss mechanism is shown to depend upon an annealable property of the material. The experimental results show a resistance independent of current level as predicted by the model. (Disser. Abstr.)

46297 THE EFFECT OF HIGH ELASTIC UNIAXIAL STRAIN ON THE RESISTIVITY AND THE SUPERCONDUCTING TRANSITION TEMPERATURE OF TIN WHISKERS. Davis, Jack Hayne. Clemson, S. C., Clemson Univ., 1966. 73p.

Thesis.

Since bulk single crystal tin is soft and ductile only the effects of small elastic uniaxial stress (σ) on the resistivity and superconducting transition temperature (T_c) have been measured. These results produced only a first-order coefficient; i.e., the slope of the curve at zero stress. By using high strength single crystal tin whiskers the maximum elastic stress was increased by two orders of magnitude. The effect of strain in the ⟨100⟩ direction on both resistivity and T_c was found to be highly nonlinear with less nonlinearity in the ⟨101⟩ direction and practically none in the ⟨001⟩ direction. These data in the low strain limit agree with previous first order stress data obtained by Grenier for critical field (H_c) and by Allen for resistivity. From our data the second order critical field coefficients $(\partial^2 H_c/\partial\sigma_1^2)$ and $(\partial^2 H_c/\partial\sigma_3^2)$ are estimated to be 3.4×10^{-6} (gauss/atm.^{2}) and 7×10^{-9} (gauss/atm.^{2}) respectively. This quadratic behavior explains the unusually high anisotropy of the stress effect on H_c observed by Seraphim and Marcus and may also account for the factor of six difference between their value of $\partial H_c/\partial\sigma_1$ and Grenier's value. Second order strain coefficients of resistance $(\partial^2 R/R\partial\epsilon^2)$ were found to be 140 for the ⟨100⟩ and less than 10 for the ⟨001⟩ direction. Since the first order resistivity ⟨100⟩ coefficient of resistivity is negative, a minimum in resistivity is found at 1.4% strain. Six observations are made which tend to indicate that Fermi surface distortion is responsible for the nonlinearities observed in the ⟨100⟩ direction. (auth) (Disser. Abstr.)

46298 IMPROVEMENTS IN OR RELATING TO CRYOGENIC APPARATUS FOR LOW TEMPERATURE IRRADIATION. Depierre, Yves; Verdier, Jacques (to Commissariat a l'Energie Atomique). British Patent 1,087,507. Oct. 18, 1967. Priority date Mar. 9, 1965, France.

An apparatus for low-temperature irradiation is described; it comprises a fluid-tight, thermally insulated vessel for containing in its lower portion a bath of cryogenic liquid to be exposed to an intense radiation flux. It also comprises a fluid-cooled heat exchanger, for condensing vapors formed in the bath, which is cooled by the working fluid of a cryogenerator. The working fluid is subjected to a Stirling cycle. The cryogenerator is located in a zone of low irradiation flux and at a level higher than the bath so that the condensed cryogenic liquid returns to the bath by gravity. (M.H.R.)

46299 STRUCTURE OF THE JOSEPHSON CURRENT PRODUCED BY AN ELECTROMAGNETIC FIELD AND FREE INDUCTION DECAY IN A MAGNETICALLY DILUTE SOLID. Wu, Tsu-ming. Philadelphia, Univ. of Pennsylvania, 1966. 127p.

Thesis.

PART ONE: Structure of the Josephson Current Produced by an Electromagnetic Field—Within the Valatin–Bogolyubov quasiparticle approximation, Riedel has recently shown that the amplitude of the ac Josephson current has a logarithmic singularity when the bias voltage $V_0 = 2\Delta_0/e$. Here, the Josephson current

amplitude in the presence of an external electromagnetic field is investigated using the Nambu–Eliashberg Green's function formalism. The introduction of Green's functions allows taking account of damping and retarded nature of the electron–phonon interaction. This derivation emphasizes the enhancement of the critical dc Josephson current by a microwave field when the frequency approaches $\omega = (2\Delta_0(T)/n)$ (where n is an integer) and the step discontinuity of the magnitude of the ac Josephson current by the dc voltage V_0 when eV_0 approaches $2\Delta_0(T)$. PART TWO: Free Induction Decay in a Magnetically Dilute Solid—For simplicity an isotropically disordered cubic lattice having a fraction p of lattice sites occupied by spin-½ nuclei and the remaining sites occupied by spin zero nuclei is considered. A perturbation calculation of the free induction decay in powers of the rotationally invariant part of the truncated dipolar interaction is carried out. This is an adaption of the Lowe and Norberg calculation to the case of a magnetically dilute system. The decay curve is numerically evaluated for the case in which the dc magnetic field is along the [100] axes. It is found that the amplitude of the initial beat is enhanced as p decreases between 1.0 and 0.5. Abragam has suggested that the free induction decay can be expressed as $e^{-a^2t^2/2}(\sin bt/br)$. Here a and b are determined from the exact evaluation of the second and fourth moments of the line shape. For p = 1 this gives excellent agreement with experiment. However, using the results for the moments of a dilute magnetic system to determine a(p) and b(p), it is found that the initial beat amplitude decays as p decreases. A discussion of the physical processes responsible for the beats suggests that the conclusion drawn from the perturbation calculation is correct and that the initial beat increases as p decreases from 1. (TSS) (Disser. Abstr.)

Plasma and Thermonuclear Physics

46300 (AD-641083) PLASMA RESEARCH. Quarterly Progress Report No. 3, July 1–September 30, 1965. Birdsall, C. K.; Lichtenberg, A. J.; Trivelpiece, A. W. (California Univ., Berkeley. Electronics Research Lab.). Contract AF33(615)-1078. 44p. (AFOSR-66-2365). CFSTI $3.00 cy, $0.65 mn.

Progress is reported on experimental and theoretical research in problems of creation, containment, heating, stability, radiation, and measurement of the physical and electromagnetic properties of high and low temperature plasmas. The hot-electron experiment operated without difficulty during most of the report period. Most of the effort was concerned with obtaining adequate data to determine the absolute intensity of the synchrotron radiation emitted by the hot-electron plasma. The electron and loss energy analyzer was completed, and the electron end-loss plasma camera used in conjunction with an image converter was used to improve the estimates of the size and location of the plasma. The inconclusive results of the laser-scattering experiments have led to a study of the scattering of laser photons by a hot-electron plasma. A turbulent heating experiment was performed in order to study ion heating by an electron current modulated at the ion-cyclotron frequency. Calibration of the ion energy analyzer is proceeding. A description of the turbulent heating experiment is presented. The experimental apparatus for plasma instability experiments is being prepared. An analysis of flute modes in a mirror machine plasma with diffused boundary was completed. Related research includes the testing of a computer model for nonlinear investigation of plasma interchange instability, investigation of the damping and instabilities of cyclotron waves in a plasma, and the study of nonlinear interaction of an electron with an electromagnetic wave. (auth) (TAB)

46301 (UCRL-50002-67) CONTROLLED THERMONUCLEAR RESEARCH. Annual Report, July 1965–June 1967. (California Univ., Livermore. Lawrence Radiation Lab.). July 5, 1967. Contract W-7405-eng-48. 209p. Dep. CFSTI.

Separate abstracts were prepared for the 6 included sections. (M.O.W.)

For abstracts of individual sections see: 46302, 46306–46309, and 46335.

46302 (UCRL-50002-67, pp 147-68) THEORETICAL AND BASIC EXPERIMENTAL PLASMA PHYSICS. (California Univ., Livermore. Lawrence Radiation Lab.).

Summaries of research are given on the following: large-volume neutral injection magnetic mirror experiments, numerical solution of the Fokker–Planck equation for a hydrogen plasma formed by neutral injection, numerical model for a plasma in a mirror machine, calculation of toroidal magnetic field configurations, a code for guiding center trajectories, stability of levitated current rings, computation of equilibrium configurations of a toroidal plasma, numerical studies of anomalous diffusion, trapping mechanisms and E-layer amplitudes, numerical studies of Astron E-layer formation, a program for computing self-consistent fields in Astron, pulse propagation in unstable media, nonlinear theory of negative mass instability, the negative mass instability, Cherenkov trapping of current loops in a plasma, Ion cyclotron instabilities in the presence of gradients, formation of excited hydrogen atoms by charge exchange in ground state atoms, E/B velocity shear effects on plasma interchange modes, effect of inductive and capacitive walls on the Diocotron instability, and atomic scattering and cross section measurements. (M.O.W.)

Confinement and Heating of Plasma

Refer also to abstract 46336.

46303 (CONF-661041-14) NUMERICAL AND EXPERIMENTAL INVESTIGATIONS ON COLLISIONFREE COMPRESSION OF A PLASMA WITH ANOMALOUS FRICTION. Chodura, R.; Igenbergs, P. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). [nd]. 13p. Dep.

From 1st European Conference on Controlled Fusion and Plasma Physics, Munich, Germany.

Friction of electrons moving under the action of an induced electric field in a dilute collisionless plasma was investigated by comparison of numerical calculations with experimental results. Calculations were made for a cylindrical plasma in an axial time-varying magnetic field. The behavior of the plasma was treated by two-fluid equations including a friction term for the electron component as was used by Adlam, Holmes and Bardotti, Cavaliere, and Engelmann to describe in a phenomenological way the action of a two-stream instability on electron motion. This term forces the electron velocity to stay under a critical value and simultaneously describe the conversion of energy of directed motion in energy of unordered motion. Free parameters in this friction term were to be determined by experiment. The investigations were made in a density regime $(2 \times 10^{11} - 5 \times 10^{12}\ cm^{-3})$ where the characteristic length C/ω_{pe} for the structure of magnetic field, density etc. is comparable to or larger than the radius of the plasma. In this case there are no limitations on the strength of the induced field, which are imposed in the other case by an unadmissible steepening of the front of the compression wave. Calculated current distributions are compared with probe measurements of magnetic fields. (auth)

46304 (ORO-3516-2) INVESTIGATIONS OF ANOMALOUS DIFFUSION IN LINEAR E-TYPE RF DISCHARGES. Final Report. Powers, E. J. (Texas Univ., Austin). Aug. 23, 1967. Contract AT(40-1)-3516. 7p. Dep. CFSTI.

An investigation was made of enhanced plasma transport across a static magnetic field in an E-type, rf discharge. It is observed experimentally that once the magnetic field exceeds a certain critical value, the rate at which plasma is transported across the field is well in excess of that predicted by classical diffusion theory. A preliminary instability calculation was made. The results indicate that ion-acoustic instabilities may be responsible for the anomalous diffusion. (M.O.W.)

46305 (SIT-2582-24) EVIDENCE FOR LONG-TIME CONFINEMENT OF DENSE PLASMA BY MEANS OF TWO Θ PINCHES AND A CUSP (CHALICE). Yevick, George; Harvey, Robin; Schiff, Morton; Opat, Henry (Stevens Inst. of Tech., Hoboken, N.J.). [1966]. Contract AT(30-1)-2582. 11p. (CONF-670928-4). Dep. CFSTI.

From Pulsed High-Density Plasmas Conference, Los Alamos, N. Mex.

Experimental evidence is presented for the confinement of plasmas having particle densities greater than $3 \times 10^{16}\ cm^{-3}$ and confinement times at least 20 μsec by means of two θ pinches and a cusp (Project CHALICE). Two-color Mach–Zehnder streak interferograms are taken looking down the length of the system. The streak itself lasts for 100 μsec and a plot of time-dependent radial density is obtained. The deuterium is preheated with a 7.5-μf capacitor-powered, weak, linear pinch. The two θ pinches are produced by a fast θ-pinch bank (64 μf) with rise times of 1 μsec and then crowbarred. Simultaneously with the θ-pinch bank a cusp bank (135 μf) is switched on. The half life of the crowbarred magnetic field of the cusp bank is 50 μsec. At the present time, operation is at low voltages, yielding magnetic fields of 20kG for θ-pinch bank and 27-kG cusp bank, at the line escape of the cusp. Mach–Zehnder data were taken with all possible combinations of the three banks. Only the combination of the preheater, θ-pinch, and cusp bank yields a dense, long-confinement-time plasma. (auth)

46306 (UCRL-50002-67, pp 7-58) MAGNETIC MIRROR PROGRAM. (California Univ., Livermore. Lawrence Radiation Lab.).

Research work is described for the following areas: multistage high-compression experiments, Table Top IV, ALICE plasma experiments, computer investigation of ion orbits in ALICE quadrupole magnetic field, beam development, cross section measure-

ments in magnesium vapor, vacuum and surface physics, deflection of streaming atoms by absorption of resonance radiation, and the effect of stochastic electric fields on trapped particle distribution functions. (M.O.W.)

46307 (UCRL-50002-67, pp 59-104) ASTRON PROGRAM. (California Univ., Livermore. Lawrence Radiation Lab.).

Experimental and theoretical work of the Astron group is presented for the following: high-level single-pulse trapping in Astron, axial survey of E-layer dump, transit time experiment, axial beam structure during injection, effect of bunching on trapping, computational model of electron injection and trapping, Astron accelerator design study, availability of phase space during the buildup of the E-layer, and theoretical model of the axial current and magnetic field distribution of the E-layer. Future work is outlined. (M.O.W.)

46308 (UCRL-50002-67, pp 105-26) LIVERMORE TOROIDAL CONFINEMENT PROGRAM. Anderson, Oscal A. Jr.; Birdsall, Charles K.; Birdsall, Dale H.; Furth, Harold P.; Hartman, Charles W.; Lauer, Eugene J.; Munger, Richard H. (California Univ., Livermore. Lawrence Radiation Lab.).

Plasma confinement studies in the Levitron device were made for three different plasma densities. Magnetic field calculations were made on the $l = 2$ toroidal stellarator. Results are given for the Hybritron modification for $\theta \approx 0.1$, $V'' < 0$. Properties of a new superconducting Levitron are described. (M.O.W.)

46309 (UCRL-50002-67, pp 169-81) ENGINEERING DEVELOPMENT. (California Univ., Livermore. Lawrence Radiation Lab.).

Research summaries on the engineering aspects of the following are presented: magnetic mirror program, Astron, expanded computer program for calculating hollow conductor project, cryogenic project, superconducting saddle coil, and vacuum and component development. (M.O.W.)

46310 CALCULATION OF THE HEATING BY AN ELECTRIC FIELD OF A LORENTZ IMPERFECTLY HOMOGENEOUS PLASMA. Hubert, Daniel; Jancel, Raymond (Institut Henri-Poincare, Paris). Compt. Rend., Ser. A and B, 264: 1783-6(June 26, 1967). (In French).

The Boltzmann equation proposed by Mintzer (Phys. Fluids, 1076 (June 1965)) for the calculation of the electron distribution function of an imperfect Lorentzian plasma perturbed by an electric field was resolved. The evolution of the temperature of the electron component was studied. (tr-auth)

46311 HIGH-BETA PLASMAS IN THETA PINCHES AND CUSP EXPERIMENTS. Ribe, F. L. (Los Alamos Scientific Lab., N. Mex.). Nucl. Fusion, 7: 81-9(Sept. 1967).

High-β plasmas are those whose diamagnetic currents react strongly on the confining magnetic field. Examples of such plasmas, in which the field is largely excluded from the plasma, are those in linear θ pinches and cusp-compression devices. In the former, measurements show β (the ratio of particle and magnetic pressures) to lie typically in the range 0.6 to 0.9. The sheath which separates the plasma from the confining magnetic field has the dimension c/ω_{pi} (the ion collisionless skin depth), indicating that sheath ions carry the current. Theta-pinch and cusp experiments are described in which the basic limitation on plasma containment is end or cusp loss. In both cases the dimension of the loss "hole," out of which plasma flows, is found to be a few ion Larmor radii. A simple theoretical argument is given to show that gross flute instabilities depend sensitively on the collisionless or collision-dominated nature of the high-β plasma. In the case of θ pinches experimental evidence for this effect is given, and its relevance to stabilization of a toroidal θ pinch is discussed. (auth)

46312 LASER RADIATION HEATING OF A PLASMA IN A STRONG MAGNETIC FIELD. Shkuropat, P. I.; Shneerson, G. A. (Leningrad Polytechnic Inst.). Zh. Tekh. Fiz., 37: 1161-5 (June 1967). (In Russian).

A quantitative investigation was made of the containment of a plasma by a strong magnetic field during heating of the plasma by a laser beam. The analysis proceeds from the basic assumptions and equations of Basov and Krokhin (Zh. Eksp. Teoret. Fiz., 46: 171 (1964)) which establish the dependence of the heat transfer to the plasma as a function of its rapidly decreasing density during the process of its expansion in the absence of a magnetic field. The effect of an external longitudinal magnetic field is to restrict the spatial expansion to one-dimensional expansion, thereby retaining the density and the heat absorption capacity at a higher level for a longer period of time. A substantial reduction (more than one order) in the power requirement for heating the plasma to a given temperature can be achieved, in the case of a plasma in the form of an elongated cylinder, by the application of a containing magnetic field. Rough estimates based on simplifying assumptions indicate, however, that the magnetic field strength needed for a substantial increase in the heating efficiency, would be close to the limit achievable at the present time. (ATD)

46313 MECHANISM OF POSITIVE LOW PRESSURE COLUMN IN THE LIMITING CASE OF SMALL ELECTRON DENSITIES. III. THE DIFFUSION THEORY OF THE HOMOGENEOUS POSITIVE COLUMN. Rutscher, A.; Peau, S. (Univ., Greifswald, Ger.). Beitr. Plasmaphys., 7: 187-201(1967). (In German).

On the basis of the energy distribution function for electrons valid for small current densities, the diffusion theory of the homogeneous positive column in Ne was developed in consideration of step processes and deviation from quasi neutrality. By the method of passing to a special discharge a series of atomic characteristic sizes of Ne can be determined indirectly. The experiments carried out confirm the similarity law of the low-current column obtained from theory and the behavior of the axial column field intensity observed in irradiation and gas temperature modification. The quantitative agreement between theory and experiment under very different conditions supports the atomic magnitudes obtained by extrapolation. (tr-auth)

46314 HEATING OF A PLASMA BY A LARGE AMPLITUDE CYCLOTRON WAVE. Dubovoi, L. V.; Fedyakov, V. P. Zh. Eksp. Teor. Fiz., 53: 789-95(Sept. 1967). (In Russian).

The efficiency of plasma heating by a large amplitude ion cyclotron wave is investigated experimentally. A hydrogen plasma preheated to a temperature of 1 keV by electrons is employed in the experiments. Anomalous strong decay of the large amplitude ion cyclotron wave is observed. Complete transfer of the wave energy to thermal energy of the particles occurred during less than 10^{-6} sec. Under optimal conditions up to 70% of the energy accumulated in the shock circuit generating the wave was transmitted to the plasma. For a particle concentration of 10^{13} cm^{-3} the energy density in the plasma produced as a result of heating is $n(T_e + T_i) \sim 2 \cdot 10^{16}$ eV $\cdot$ cm^{-3}. The experiments were performed with magnetic mirror traps. (auth)

46315 HIGH-POWER RF PLASMA HEATING AND WAVE PROPAGATION NEAR THE FUNDAMENTAL AND HARMONICS OF THE ION CYCLOTRON FREQUENCY. Kristiansen, Magne. Austin, Tex., Univ. of Texas, 1967. 149p.

Thesis.

Generation, propagation, and damping of fundamental and harmonic ion cyclotron waves were investigated experimentally and theoretically. A "magnetic beach" geometry is used and the waves are excited by a Faraday shielded Stix coil from a 30 kW, 5.8 MHz driver. The Stix coil has four sections with a periodicity (wavelength) of 16 cm. An E_z shielding efficiency of approximately 75% is obtained by use of the Faraday shield. The plasma is subjected to an axial magnetic field which is uniform ($\pm\frac{1}{2}$%) in the Stix coil region and which has a 45 cm long, 16.5% "magnetic beach" for wave propagation studies. Maximum magnetic field in the Stix coil region is 10.6 kG. The plasma loading of the Stix coil, the cutoff conditions for the fast wave, and optimum coupling conditions were calculated and measured. Grounding of the beach end of the plasma tube led to apparent plasma fluctuations which are related to the onset of axial rf currents in the plasma. A new wave phenomenon was observed during the experimental investigation. It was observed that for certain experimental conditions the ion cyclotron waves propagate for frequencies above the ion cyclotron frequency f_c. The harmonic number G at which the waves attenuate is found to be pressure dependent such that G increases for increasing gas pressure. Both hydrogen and deuterium plasmas were investigated. Attenuation at harmonics up to the 8th was observed. Spatial measurements of the wave magnetic fields were made with magnetic probes for several plasma densities and confining magnetic fields in a "magnetic beach" geometry. Axial measurements of the wave magnetic fields demonstrate the wave propagation and wave damping. Radial measurements of the wave magnetic fields indicate a higher order transverse mode structure. Diamagnetic probe measurements show that enhanced plasma heating occurs whenever the wave fields attenuate at harmonics of f_c. A discussion of the observed phenomena is presented. It is shown that a higher order transverse mode structure may be expected under experimental conditions similar to those reported here. Particle acceleration at harmonics of the cyclotron frequency for the case of higher order transverse modes and finite Larmor radii is briefly described. Finite temperature plasma theory, where harmonic effects are inherent, is shown to apply for even moderately hot plasmas provided the radial wave number is large. An experimental investigation was made of the Faraday shield-Stix coil combination. Improvements in spatial wave form and E_z shielding were obtained. An extensive chronological bibliography for ion cyclotron and ion–ion hybrid resonance phenomena is compiled. (Disser. Abstr.)

Diagnostics of Plasma

Refer also to abstracts 45475 and 45478.

46316 (JUL-473-PP) DIELEKTRISCHE LEITER UND ANTENNEN FUER 2mm-MIKROWELLENINTERFEROMETER HOHER RAEUMLICHER AUFLOESUNG ZUR DICHTEMESSUNG AN PLASMEN. (Dielectric Conductor and Antenna for 2-mm Microwave Interferometer of High Spatial Resolution for Density Measurements on Plasmas). Hartwig, H. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Plasmaphysik). Apr. 1967. 7p. (In German). Dep.

A dielectric antenna and dielectric conductor were constructed for a 2-mm microwave interferometer. The smallest gap of the conductor and various types of antenna curvatures were experimentally studied. The radiation diagram of various forms of the free conducting end were also measured. In testing of the interferometer function there was a linear dependence between dielectric strength and phase displacement. Density measurements were carried out in a plasma experiment using the dielectric conductor and antenna. A comparison was made between a measured interferometer signal and a calculated interferogram. The spatial dependency of the pattern of the electron density is shown. (J.S.R.)

46317 (LA-tr-67-77) ELECTRON-OPTICAL METHOD OF RECORDING THOMSON SCATTERING OF LITHT OF A RUBY LASER BY A PLASMA. Dolgov-Savel'ev, G. G.; Iskol'dskii, A. M.; Krugliakov, E. P., Malinovskii, V. K. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki). Translated by Helen J. Dahlby (Los Alamos Scientific Lab., N. Mex.), from a Preprint. 10p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

Preliminary experiments are described in which a simultaneous measurement of local instantaneous values of n_e and T_e was conducted. (M.O.W.)

46318 MEASUREMENT METHODS OF PLASMA PHYSICS. Patt, Hans-Josef (Technische Hochschule, Aachen). VDI (Ver. Deut. Ing.) Z., 109: 885-90(July 1967). (In German).

For the measurement of the properties and entropies of plasma, special measurement methods were developed. These can be divided into passive and active methods. In the passive method the information carrier of the measurement data is produced in the plasma itself and then modulated in suitable measurement devices; according to the type of information carrier, photographic, spectrographic, and nuclear physical methods can be distinguished. In the second group electromagnetic radiation, beams, or probes are caused to interact with the plasma and the effects produced are measured in various ways. The principal method in these two types of measurements is briefly described. (J.S.R.)

46319 PLASMA PHASOGRAPHY. Presby, Herman M.; Finkelstein, David (Yeshiva Univ., New York). Rev. Sci. Instrum., 38: 1563-72(Nov. 1967).

The phase-contrast microscope of Zernike may be scaled in size and combined with giant pulse ruby-laser illumination to make possible the observation of macroscopic moving tenuous objects, such as jets, shock waves, and plasmas. The resulting instrument, referred to as the laser phase contrast (LPC) system, has performance similar to that of an optical interferometer operated in the single-fringe mode. The operation of the LPC system is treated theoretically and conditions for optimum imaging are derived. The phase plate of Zernike is modified into a phase mirror for use with focused laser illumination. Quite different mirrors are required for the full range of interesting plasmas accessible to the LPC system. The experimental model is described. Phasograms of weak and strong shocks in air and argon down to 0.5 mm Hg pressure are shown. Rayleigh-Taylor instability behind the shock is observed. Gas jets of various refractivities are also used as test objects. Phasograms of vacuum sparks producing jets of ablated electrode material are shown. Many objects studied are invisible to schlieren photography using the same illumination and optics. (auth)

46320 MEASURING THE ELECTRON TEMPERATURE OF A POWERFUL PULSED DISCHARGE. Zemtsov, Yu. K.; Pismennii, V. D.; Rakhimov, A. T. (Moscow State Univ.). Nucl. Fusion, 7: 155-9(Sept. 1967).

The electron temperature of a plasma ($N_e \sim 10^{17}$ cm^{-3}) produced by a powerful pulsed discharge was measured by the relative intensity of the spectral lines from lithium-like impurity ions. For such calculations it is necessary to know the population of the different ionic levels; this was found by solving a system of balance equations describing the processes which give rise to population and depopulation of levels. It has been found that under experimental conditions ($N_e \sim 10^{17}$ cm^{-3}) the population of the lower levels of the ions under consideration is close to a Boltzmann population, relative to the ground state. The higher levels are in thermodynamic equilibrium with continuum but the population of these levels, relative to the ground state, is considerably smaller than a Boltzmann population. Calculations have been made of the α corrections which show the deviation from a Boltzmann population relative to the ground state. With these corrections it was possible to obtain internally consistent values of the electron temperature ($T_e \sim 20$ to 30 eV) over the entire emission spectrum (from 150 to 2000 Å). (auth)

46321 INVESTIGATION OF THE DEPENDENCE OF PLASMA RESISTANCE ON THE ELECTRIC FIELD INTENSITY. Demidov, B. A.; Elagin, N. I.; Fanchenko, S. D. Dokl. Akad. Nauk SSSR, 174: 327-9(May 11, 1967). (In Russian).

In view of the importance of this question to plasma heating in closed magnetic traps, the author measured the conductivity, as a function of the electric field intensity, of a plasma of density 10^{11} to 10^{12} cm^{-3} produced by injection in a toroidal quartz discharge chamber (major and minor radii 50 and 8 cm), in which a quasi-stationary containing field of intensity up to 10 kG was produced by a system of 20 coils equidistantly distributed along the perimeter. Switching the coils produced a field that was either almost homogeneous along the torus perimeter or spatially periodic (strongly corrugated). A vortical electric field of 200 kHz frequency was applied along the perimeter. The tests consisted of determining the volt ampere characteristics of the discharge, the microwave radiation of the plasma at the electron plasma frequency, and the distribution of the current over the cross section of the plasma pinch. The plasma resistance was calculated from the current and voltage oscillograms. The results show that in low electric fields the effective conductivity corresponds to the usual conductivity of a preliminary plasma. When the critical value of the Dreicer field is increased, the conductivity drops abruptly, and evidence of plasma-oscillation buildup appears. Further increase of the field (by a factor 10 to 20), a plateau of conductivity is observed, followed by a second drop in conductivity. The anomalous active resistance of the plasma in strong fields agrees with earlier measurements by the authors. The results were approximately the same for a homogeneous or corrugated magnetic field. (ATD)

46322 PROBE STUDIES OF A LOW-VOLTAGE CESIUM ARC BETWEEN EMITTING ELECTRODES. Dyuzhev, G. A.; Martsinovskii, A. M.; Moizhes, B. Ya.; Pikus, G. E.; Yur'ev, V. G. (Inst. of Semiconductors, Leningrad). Zh. Tekh. Fiz., 37: 1155-7(June 1967). (In Russian).

A 0.1-mm-diameter molybdenum probe was used to measure the charged particle concentration, potential, and electron temperature in cesium arcs between indirectly heated plane molybdenum electrodes mounted 1.5 mm apart. The measurements were undertaken because of the technical importance of low voltage cesium arcs in connection with thermoelectronic energy converters. The arcs burned in cesium vapor at pressures from 0.44- to 2.0-mm Hg with a fixed current density of 1.8 A/cm^2. The cathode temperature was held constant at close to 1400°K and the anode temperature was varied from 800 to 1250°K. The floating probe potential and saturation probe current were automatically recorded as functions of the position of the probe between the electrodes, and from these data the charged particle concentration, electric potential, and electron temperature distributions between the electrodes were calculated. The results are presented graphically and are discussed very briefly. As the anode temperature was increased with the arc current held constant, the total voltage across the arc, the charged particle concentration in the plasma, and the potential drop at the cathode barrier all increased; the electron temperature also increased slightly. (ATD)

46323 ROLE OF THE OUTPUT VOLTAGE IN THE SPACE POTENTIAL DETERMINATION BY MEANS OF INCANDESCENT PROBES. Arndt, Rudolf; Scheibner, Helmar (Univ., Greifswald, Ger.). Beitr. Plasmaphys., 7: 167-85(1967). (In German).

Index plotting and control studies were made on the introduction of tungsten incandescent probes in the positive column of the He and Ne discharges. It was shown that, for the probe used, the change of the output voltage effects the displacement of the characteristic lines occurring in the heating of the probe. Long probes are better for accurate potential measurements because of their homogeneous temperature distribution. Short probes have an output voltage distributed according to their temperature along the filament. The output voltage effective for the total probe is therefore an average value which lies at sufficient probe temperatures in the vicinity of the value for pure tungsten. The emission current part of the characteristic was used for the evaluation so that the output voltage of the pure tungsten can be used in the calculations. If the site of the space potential can be determined relative to the characteristic line of the cold probe, then the effective output voltage of the total probe is obtained. (tr-auth)

46324 THE PLASMA COMPOSITION OF A Na-CONTAINING Ar ARC LIMITED BY A ROTATING WATER HOLLOW CYLINDER. Neumann, Werner; Serick, Felix (Physikalisch-Technisches Institut, Berlin). Beitr. Plasmaphys., 7: 203-20(1967). (In German).

Investigations of the compositions of a Na-containing Ar plasma which burned inside a rotating water hollow cylinder W between filled graphite electrodes at a current strength of 10 A were reported. The filling substance consisted of 36.4% C, 42.5% NaCl and 21.1% CuO. Electron temperature, electron density, and ion and neutral gas density of the elements Na and Cu were determined from the intensities of Na(I) and Cu(I) lines. Because of the light scattering on the curved water interior surface a scattering corrector was introduced. For the C content an upper limit of 2×10^{15} cm^{-3} was given over the evaporation rate. The H_2 content was determined from the current balance as 1.2×10^{16} cm^{-3}. A relation for the pressure equilibrium of the water evaporated and dissociated from the water surface in the arc yields about the same value. A H_2 concentration too small by a factor of 5 was obtained in the assumptions of thermodynamic equilibrium. This means therefore that the H_2 term n = 3 is 5 times under the Boltzmann value. The possible application of the arc arrangement to the testing of the Boltzmann distribution in the atomic system of Ar at variable electron densities was discussed. (tr-auth)

46325 CHANGES IN THE VARIABLE POTENTIAL OF THE LANGMUIR PROBE TO THE EFFECT OF ALTERNATING VOLTAGE. Godyak, V. A.; Ivanov, A. N.; Kuzovnikov, A. A. (Moscow State Univ.). Zh. Tekh. Fiz., 37: 1063-7(June 1967). (In Russian).

An expression has been obtained for changing the variable potential of the Langmuir probe to the effect of alternating voltage potential of a high amplitude. The increase of variable potential over a wide range does not depend on the frequency of the applied voltage which is the function of its amplitude and plasma electron temperature. The experimental results presented are in good agreement with the theoretical equation. (ATD)

46326 STARK EFFECT IN HIGH-FREQUENCY STOCHASTIC FIELDS IN A PLASMA. Lifshits, E. V. (Physical-Technical Inst., Kharkov). Zh. Eksp. Teor. Fiz., 53: 943-52(Sept. 1967). (In Russian).

The Stark effect in high-frequency stochastic fields in a plasma is analyzed theoretically. Relations are obtained which relate the spectral line width and the electric field strengths for the cases of stochastic oscillations and superposition of regular and stochastic oscillations. It is shown that the Stark effect in varying stochastic and regular high-frequency or low-frequency fields can be employed effectively for determining the main parameters of an unstable turbulent plasma. (auth)

46327 TOPLER SETUP WITH A PULSE RUBY LASER FOR INVESTIGATION OF A PLASMA SHEATH. Vinogradov, V. P.; Golubchikov, L. G.; Filippov, N. V.; Filippova, T. I. (Inst. of Atomic Energy, Moscow). Teplofiz. Vys. Temp., 5: 343-8 (Mar.-Apr. 1967). (In Russian).

The optical method of the Topler-type investigation of rapidly changing plasma sheaths by photographing them in penetrating light is developed. Because of high brightness of the plasma itself, a pulse ruby laser of ~2 Mw power with a pulse duration ~40 nsec was used as a light source. In the setup, plasma was illuminated with a laser light passing through a light guide 1 mm in diameter and a collimating lens. After penetrating the plasma, the light was focussed again by another, identical lens onto an aperture from which it was imaged onto the film by a third lens. When optical inhomogeneities are present in the plasma with a density gradient in the direction perpendicular to the optical axis, a part of the collimated light is deflected and does not reach the aperture. Therefore, optical inhomogeneities appear darker in comparison to the overall light background. A special discharge camera is also described. Instant photographs of the successive motion of a plasma sheath, formed at a pulse discharge in rarefied gases, are shown, upon which some conclusions about the form and structure of the sheath at the considered instant of the discharge development are based. (ATD)

46328 EVALUATION OF CONDUCTIVITY TEMPERATURE DEPENDENCE IN MAGNETOGASDYNAMIC FLOW. Vulis, L. A.; Dzhaugashtin, K. E.; Fomenko, B. A. Teplofiz. Vys. Temp., 5: 288-93(Mar.-Apr. 1967). (In Russian).

A simple magnetohydrodynamic flow was used to demonstrate an effective approximation method for studying hysteresis phenomena related to the temperature dependence of plasma conductivity. (tr-auth)

46329 EXPERIMENTAL STUDY OF AN ELECTROACOUSTIC WAVE EXCITED BY AN ANTENNA IN A HOT PLASMA. Chen, K. M.; Judson, H.; Lin, C. C. (Michigan State Univ., East Lansing). Proc. IEEE (Inst. Elec. Electron. Eng.), 55: 1636-7(Sept. 1967).

An experimental study has been conducted to search for the electroacoustic wave which is excited by an antenna in a hot plasma. It was observed that an electroacoustic wave is excited when the average local plasma frequency in the antenna vicinity is near the antenna frequency. However, no electroacoustic wave is excited if the plasma frequency is sufficiently lower than the antenna frequency. (auth)

Kinetics of Plasma

Refer also to abstracts 46127, 46172, 46202, and 46306.

46330 (JUL-493-PP) ERGEBNISSE AUS REFRAKTIONS-MESSUNGEN SENKRECHT ZUR ACHSE EINES THETA-PINCH-PLASMAS. (Results of Refraction Measurements Perpendicular to the Axis of a Theta-Pinch Plasma). Dippel, Karl Heinz (Kernforschungsanlage, Juelich (West Germany). Institut fuer Plasmaphysik). June 1967. 84p. (In German). Dep.

Investigations carried out with an interference refractometer on a H_2 plasma of high temperature ($T_{max} > 10^{6}$°K) and high density ($n_{max} > 10^{17}$ cm^{-3}) produced in a θ-pinch device are described. In contrast to the earlier refraction measurements made on θ-pinch plasmas the measurement beam of the refractometer was placed not parallel to the axis of the plasma column but perpendicular. In addition to the development of a light source which permitted a time resolution in the inteferogram of about 10^{-8} sec, an increase of the measurement sensitivity was necessary. An accuracy in the determination of the displacement h of the interference band system $\Delta h = \pm 1/100$ band width could be obtained. An accurate determination of the line density is possible from measurement perpendicular to the axis. The evaluation of the interferogram shows in the initial phase of the discharge strong axial mass motions, which were probably dissolved by magnetic field inhomogeneities at the end of the plasma column. The solution of the Abel integral equation of electron density distributions is given with a space resolution of about 0.5 mm. In the initial phase of the discharge density, structures with a decided term occurred with supplementary imposed magnetic field. This was only weakly indicated in measurements parallel to the axis. At later times the density profiles from measurements parallel and perpendicular to the axis are similar to each other. The lines and electron densities arising from the refraction measurements perpendicular to the axis of the plasma column were compared with values from two other measurement methods. The comparison of the refractometry-determined line density with the line density from the frequency of the radial oscillations from the plasma column gave a satisfactory agreement. Deviations occurring in the initial phase can be traced back to the axial motion in the plasma column; lower deviations at later times were probably caused by the altered density distribution. The refractometry-determined electron densities were compared with the densities obtained from the absolute measured intensity of the continuum emitted by the plasma column in the visible spectral range. In largely methodical agreement deviations occur which lie outside the limits of error of the measurement. The investigation of the possible origin of these deviations leads to the result that the deviation can be caused by the defect of multiple collisions on the emission coefficients of the bremsstrahlung continuum. (tr-auth)

46331 (LA-3674) STRUCTURE OF A MAGNETICALLY DRIVEN PLANE SHOCK WAVE IN A PLASMA. Oliphant, T. A.; Hoyt, Martha S. (Los Alamos Scientific Lab., N. Mex.). Dec. 16, 1966. Contract W-7405-eng-36. 20p. Dep. CFSTI.

Numerical calculations of the structure of a plane shock wave driven by a transverse magnetic field are described. The basic MHD theory is described in detail. Progressively more difficult examples are discussed in sequence starting from the simple Thomas shock wave in air and ending with a charge neutral plasma shock wave driven by a transverse magnetic field. (auth)

46332 (N-67-18433) KINETIC EQUATION FOR AN UNSTABLE PLASMA. Price, John C. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). [1963]. 10p. (NASA-TM-X-57293). CFSTI.

The kinetic equation of Lenard and Balescu for a uniform plasma is restricted in validity for it contains integrals which diverge when the plasma is unstable, i.e., when some perturbations on the system may tend to grow expotentially in time. A more general equation is presented which is valid for both stable and unstable plasmas. The kinetic equation is non-Markoffian in that it depends explicitly on the initial value of the pair correlation function, and contains a time integral over the past behavior of the system. The kinetic equation leads to the usual H theorem and it satisfies the conservation laws. (STAR)

46333 (N-67-19043) EFFECT OF ELECTROSTATIC FIELDS ON THE PROPAGATION OF ELECTROMAGNETIC WAVES IN A FINITE TEMPERATURE MAGNETOACTIVE PLASMA. Hsieh, H. C. (Michigan Univ., Ann Arbor. Electron Physics Lab.). Oct. 1966. 72p. (NASA-CR-82372; TR-96). CFSTI.

The dispersion relations for a finite temperature two-component plasma subjected to crossed electrostatic and magnetostatic fields have been derived using the coupled Boltzmann-Vlasov-Maxwell equations under the one-dimensional, small-signal assumptions. The derived dispersion relation is given in a form in which various characteristic modes of the system can be readily identified. Moreover it is given in a form particularly suitable for a study of the coupling between the transverse circularly polarized wave and the longitudinal wave. Inspection of the derived dispersion relation reveals that the coupling of the longitudinal mode to the transverse mode may take place in the presence of a transverse electrostatic field. (auth) (STAR)

46334 (SC-RR-67-703) ELECTROSTATIC ACCELERATION OF PLASMA ELECTRONS AND IONS IN TRANSVERSE MAGNETIC FIELDS. Banister, John R.; Beckner, Everet H. (Sandia Corp., Albuquerque, N. Mex.). Oct. 1967. Contract AT(29-1)-789. 31p. Dep. CFSTI.

The theoretical behavior of plasma electrons and ions in the presence of transverse electric and magnetic fields has been examined for two cases. A complete description for all interesting electron densities has been derived for the case in which both the electric field and magnetic induction are constant. For the case of a constant electric field and a magnetic induction which increases linearly with time, the electron and ion behavior has been specified for only rarefied or dense plasmas. In both cases, the plasma was considered to be initially cold and collisionless. The importance of collisions on the findings was examined separately. The results show that the electron energy is strongly dependent on the electron density and that the average electron energy increases as the plasma density increases. The results also indicate that only an insignificant amount of momentum is imparted to the plasma in the direction of the applied electric field. (auth)

46335 (UCRL-50002-67, pp 127-46) BERKELEY PLASMA RESEARCH. (California Univ., Livermore. Lawrence Radiation Lab.).

The plasma composition in the Homopolar gun II was described. Brief summaries are presented on the following: crossed field breakdown studies, interchange stabilization by end effects, effect of electric fields in plasmas on spectral lines, Hothouse I, grazing-incidence vacuum uv spectrometer, electron capture by protons from magnesium, single and double electron capture by 7.7 to 166 keV $^3He^{++}$ in N_2, pyro-electric detectors, diffusion from a line source, and turbulence of a positive column in a strong magnetic field. (M.O.W.)

46336 (CLM-Trans-8) DYNAMICS OF THE PLASMA ENVELOPE OF A NON-CYLINDRICAL Z-PINCH UP TO THE INSTANT OF IMPLOSION. Kolesnikov, Yu. A.; Filippov, N. V.; Filippova, T. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). Translated for Culham Lab., Abingdon, Eng., from report 18/904. 12p. Dep. CFSTI. UK 2s. 6d. JCL $1.60 fs, $0.80 mf.

Experimental investigations of pulsed discharges showed the parameters of the plasma obtained by the implosion (pinching) of the current depend significantly on the initial stage of the formation of the plasma sheet, its structure and the dynamics of its motion. (auth) (UK)

46337 SOME PHENOMENA ON THE CONTACT OF A COLD ELECTRODE WITH A MOVING PLASMA OBTAINED IN AN ELECTRIC DRIVEN SHOCK TUBE. Chutov, Yu. I. (Kiev State Univ.). Ukr. Fiz. Zh., 12: 1308-16(Aug. 1967). (In Russian).

Two copper cold electrodes ($S = 0.8$ cm^2) were placed into a moving plasma obtained in an electric driven shock tube filled with hydrogen ($p_0 = 0.5$ mm Hg). Volt-ampere characteristics of these electrodes were studied both with an external emf applied to them and with an emf induced on them when the plasma moves in a transverse magnetic field H. The charge concentration n_p and electron temperature T_e without a magnetic field superposition, as well as the potential distribution with the applied and induced emf were determined in the interelectrode space with two movable probes ($S = 0.01$ cm^2). The probe measurements were possible only providing $n_p \lesssim 2 \times 10^{13}$ cm^{-3}, as at $n_p > 2 \times 10^{13}$ cm^{-3} the current quantities on the electrode and probe were equal to each other, which is apparently due to cold emission of certain surface spots. The potential distribution in the interelectrode space with the applied emf is of a usual type with a sharp cathode drop. When emf is induced, in the volume there exists a constant electric field formed by free charges on the electrode surfaces. An induced voltage change in an external circuit with current passage is concentrated in a sharp electrode drop which, however, in contrast to the case of the applied emf adjoins the electrode receiving electrons from the plasma at current passage. Effective resistance of this electrode drop grows with the increase of the magnetic field voltage. The results obtained, when emf is being induced, are possibly explained by electron magnetization immediately near electrode surfaces. (auth)

46338 SCATTERING AND TRANSFORMATION OF HELICAL WAVES IN A MAGNETOACTIVE PLASMA. Nguen Van Trong (Kiev State Univ.). Ukr. Fiz. Zh., 12: 1247-54(Aug. 1967). (In Russian).

On the basis of linear theory various processes are considered of scattering and transformation of waves on thermal fluctuations in which helical waves take part. The expressions for cross sections of corresponding scattering and transformation processes are obtained. The helical wave fluctuations are investigated in a beam-plasma system. A condition is derived under which the plasma becomes unstable. (auth)

46339 EXPLANATION OF THE DIFFUSION VELOCITY IN IONIZED GASES. Nowacki, P. J. (Inst. of Nuclear Research, Warsaw. Technical Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech., 15: 519-25(1967).

Equations are given for expressing the diffusion velocity of electrons and electron delay in ionized gases in the presence of electric and magnetic fields. The motion is represented by normal vector diagrams and equations used in the theory of MHD generators. An equation is also given for calculating the Hall coefficient for assigned parameters. (J.H.M.)

46340 CALCULATION OF THE CHARACTERISTICS OF A Cs PLASMA DURING THERMODYNAMIC EQUILIBRIUM. Sayer, Bernard; Cheret, Michel; Berlande, Jacques; Manus, Claude (CEN, Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. A and B, 264: 1780-2(June 26, 1967). (In French).

The characteristics of a Cs plasma in stationary regime exposed to a continuous electric field was calculated using a model proposed previously. The calculations were made for a region of electron density between 5×10^{11} and 10^{14} cm^{-3} and for electron temperatures between 1,800 and 3,000°K. (tr-auth)

46341 PLASMA DYNAMICS IN HIGH-FREQUENCY THETA-PINCH DISCHARGE. Decker, G. (Institut fuer Plasmaphysik, Munich). Z. Angew. Phys., 23: 304-16(Oct. 1967). (In German).

Some experiments are described, in which the magnetic field of the theta pinch discharge oscillates with a frequency of about 1 Mc. The amplitude of the magnetic field (some kG) and the filling pressure of the gas (~0.1 torr) are such that the compression and oscillation times of the produced plasma are roughly of the same magnitude as the half period of the magnetic field. It is found that a dynamic confinement of the plasma may be achieved if filling pressure, frequency and amplitude of the magnetic field are properly chosen. Three models are applied to get a description of the plasma dynamics: the snow plough model shows how the compression velocities depend on the discharge parameters. Another simple model is applied to obtain the oscillations of a plasma column in a high-frequency magnetic field. Finally some experimental results are compared with the solutions of a magnetohydrodynamic three-fluid model. (auth)

46342 APPROXIMATIONS OF THE WEAK TURBULENCE, FOKKER-PLANCK APPROXIMATION, AND THE NONLINEAR OPTICAL APPROXIMATION. Pomeau, Yves (Faculte des Sciences, Orsay, France). Compt. Rend., Ser. A and B, 265: 24-6(July 3, 1967). (In French).

The range of validity of the theory of weak turbulence limited to the resonant interaction mechanism between waves was examined generally. With the acid of equations of this theory the condition of validity was defined. The condition of validity was also found by analyzing the mechanisms of interactions between coherent waves and resonant interactions. The weak turbulence appears finally as limited by the possibility of having oscillations of the parametric type between the wave packets caused by a great amplitude of the turbulence field and long interaction duration between the wave packets of this turbulence field. (tr-auth)

46343 VISUALIZATION OF ISOTHERMS IN AN ARGON PLASMA JET. Joubert, Francois; Vermot-Desroches, Jean-Luc (Univ., Talence, France). Compt. Rend., Ser. A and B, 265: 116-18(July 10, 1967). (In French).

In a laminar jet of Ar plasma in which a significant zone (several dm in length and 1 cm in diameter) is found at a temperature between 3,000 and 6,000°K, a seeding atom (alkalimetal or alkaline earth) sees its emission increase with temperature but, parallel, the population of emitting atoms decreases as a result of the ionization mechanism. For a given line this intensity passes through

the maximum at a temperature T_M. This temperature varies with the concentration of the seeding. (tr-auth)

46344 ELECTROSTATIC ENERGY PER DEGREE OF FREEDOM OF A TWO-TEMPERATURE PLASMA. Klevans, E. H.; Primack, J. R. (California Inst. of Tech., Pasadena). Nucl. Fusion, 7: 111-13(Sept. 1967).

The electrostatic energy per degree of freedom of a two-temperature fully ionized plasma was calculated by Rostoker, using resonant integral approximations. His results include the contributions from plasma waves and ion waves. In this note it is shown that the nonresonant contribution from electrons, i.e., the contribution from other than plasma waves, is important for the same wavelengths for which ion waves are important. Also, the validity of the resonant approximations in the ion wave region is examined by comparing Rostoker's results with those obtained by computer calculation. Although Rostoker's results give good qualitative agreement, significant quantitative disagreement is found. A more accurate approximation procedure is presented which gives better agreement with computer results. (auth)

46345 LAMINAR HYDROMAGNETIC WAVES OF FINITE AMPLITUDE IN PLASMAS OF LOW TEMPERATURE. Cavaliere, A.; Engelmann, F. (International Atomic Energy Agency, Trieste, Italy). Nucl. Fusion, 7: 137-54(Sept. 1967).

The theory of nonrelativistic hydromagnetic waves of finite amplitude in a plasma is presented in a simple, but systematic way. The emphasis is on stationary disturbances in a cold plasma. The physical meaning of the cold-plasma model, especially with respect to the description of collisional and collisionless dissipation effects, is discussed. (auth)

46346 LANDAU DAMPING AND THE MOMENTS METHOD. Sedlacek, Z. (Inst. of Plasma Physics, Prague). Nucl. Fusion, 7: 161-8(Sept. 1967).

It is shown that if the continuous spectrum of the infinite matrix belonging to the moment equations is taken into account, results completely equivalent to those obtained from the linearized Vlasov equation, including the Landau damping, are recovered. In fact, such procedure can be viewed as an alternative to the usual method of solving the Vlasov equation by integration along the unperturbed trajectory. (auth)

46347 NONLINEAR DRIFT WAVES IN A PLASMA. Petviashvili, V. I. Dokl. Akad. Nauk SSSR, 174: 66-8(May 1, 1967). (In Russian).

It is shown that the slope of the leading front of the drift waves that can propagate in a plasma in the presence of inhomogeneity transverse to the magnetic field becomes steeper with increasing time compared with the initial state, until the average frequency of the wave becomes so large that the inertia of the ions moving transverse to the magnetic field must be taken into account. In the latter case, the wave goes over into a stationary state (if the amplitude is not too large). This leads to strong turbulization of the plasma in the presence of instabilities against low-frequency drift waves, since the correlation between the oscillations in any two points of the plasma greatly weakens with increasing oscillation amplitude. The proof is obtained by obtaining for the differential equations of the plasma under these conditions a solution in the form of a one-dimensional simple Riemann wave. The reason why no shock wave can be produced under these conditions is explained. (ATD)

46348 ON THE CONNECTION BETWEEN THE BOHM CRITERIA AND THE GENERATION OF AMBIPOLAR SOUND IN A POSITIVE-COLUMN PLASMA OF A GAS DISCHARGE. Vladimirov, V. V. Dokl. Akad. Nauk SSSR, 174: 560-3(May 21, 1967). (In Russian).

The results of an earlier paper (Zh. Eksp. Teoret. Fiz., 48: 175(1965)) are used to relate Bohm's criterion for the stability of the plasma layer adjacent to the discharge-tube wall with the condition for the generation of purely azimuthal waves with frequency of the order of reciprocal time of motion of the ions in an ambipolar electric field to the tubes of the wall (ambipolar diffusion). Whereas the earlier paper was devoted to a low-pressure plasma, the present paper extends the calculation to high pressures, whereby the ambipolar sound becomes excited in a layer next to the wall of thickness larger than the Debye radius. The main distinction between the two problems is that at low pressures the entire plasma participates in the diffusion, whereas at high pressures only a certain layer takes part, and its boundary is arbitrarily chosen to be one mean free path away from the boundary defined by the Schottky conditions. A new expression for the Bohm criterion is then derived on this basis. An expression is obtained for the diffusion coefficient, which in the case of a plasma under 1-mm-Hg pressure is found to be of the order of 10^4 cm^2/sec. The critical magnetic field for excitation of ambipolar sound is somewhat higher than the critical field for excitation of screw instability under the same conditions (~1.5 kOe), and the frequency is somewhat lower (~20 kHz). The results may explain some features of the well-investigated Leehnert screw instability. (ATD)

46349 LONGITUDINAL SEPARATION OF A GAS MIXTURE IN GLOW DISCHARGE. Pekar, Yu. A. (Tula Polytechnic Inst., USSR). Zh. Tekh. Fiz., 37: 1112-17(June 1967). (In Russian).

Expressions are derived and investigated for the electron temperature, longitudinal potential gradient, concentrations of electrons and neutral impurities and the radiation intensity in a longitudinally inhomogeneous positive column of plane-symmetrical discharge in two limiting cases of a large and small impurity. The problem in zeroth approximation on behavior of these characteristics is analyzed in the transition region of cataphoresis. The theory is applied to the study of the longitudinal separation in a mixture of helium and mercury vapors. (ATD)

46350 EFFECT OF INHOMOGENEOUS HYDRODYNAMIC MOTION AND THERMAL VELOCITIES OF PARTICLES ON THE PROPAGATION OF MAGNETOHYDRODYNAMIC WAVES. Gurevich, L. E.; Grebinskii, A. S. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 37: 1006-20(June 1967). (In Russian).

An investigation has been made of the propagation of magnetohydrodynamic waves over a magnetic field in a medium enveloped by an inhomogeneous but steady-state hydrodynamic motion. It is shown that in this case, importance may be attached to the effect of nondissipative viscosity, which is proportional to temperature and therefore characterizes the thermal motion. It is also shown that the point of space, at which the geometric sum of the hydrodynamic and Alfven velocities equals zero is the specific point near which, in addition to ordinary and extraordinary waves, there exists a third wave. Finally, it is shown that in the propagation of a wave in a compressible medium, the wave's amplitude increases in space the closer it is to the specific point; the total amplitude increase in limiting cases of low and high compression rates is determined. This increase in amplitude and the decrease of wavelength lead to an increase in dissipation which is of interest in a number of astrophysical problems. The effect analyzed is similar to the common effect for the "distension" of the field of an electromagnetic wave in inhomogeneous plasma at the point where the refractive index shows a distinctive characteristic. (ATD)

46351 REFLECTION OF PLASMA BY A LINEARLY INCREASING TRANSVERSE MAGNETIC FIELD. Kovalev, A. M.; Khizhnyak, N. A. Zh. Tekh. Fiz., 37: 1052-6(June 1967). (In Russian).

The problem of Chapman and Ferraro of the reflection of plasma by a magnetic barrier was treated with the magnetic field of the barrier taken into account in an earlier paper by the authors. In the earlier paper the magnetic field of the barrier was assumed to be uniform; in the present paper the authors treat the same problem on the assumption that the magnetic field of the barrier rises linearly with distance from the barrier plane. The steady-state reflection of the plasma is treated in the two-fluid hydrodynamic approximation with neglect of collisions and the assumption of quasi neutrality. It is also assumed that the thickness of the boundary layer is much smaller than the distance to which an isolated ion, approaching the barrier with the hydrodynamic velocity, could penetrate into the barrier. The results of the calculations confirmed the validity of this approximation. Formulas are obtained for the forward velocity of the ions, the magnetic field strength, and the electric potential as functions of depth within the boundary layer, and these relations are presented graphically for three values of the rate of rise of the barrier magnetic field. (ATD)

46352 THEORY OF THE MULTIPLICATION AND EXTRACTION OF THE DIFFERENCE FREQUENCY IN A PLASMA-BEAM SYSTEM. Kotsarenko, N. Ya.; Fedorchenko, A. M. (Kiev State Univ.). Zh. Tekh. Fiz., 37: 1057-62(June 1967). (In Russian).

A theoretical investigation was made of the extraction of the difference frequency of two signals with subsequent amplification in a plasma–beam system. The calculations assumed a system situated in a homogeneous magnetic field along with the electron beam travels with a constant velocity. The problem of frequency multiplication with subsequent amplification was also considered. The formulas obtained indicate that the mechanism of frequency doubling and difference frequency extraction are sufficiently effective to be applied to studies of the nonlinear phenomena of difference frequency generation. They may also be useful for the construction of effective mixers in the region of superhigh frequencies. However, the authors note that the case of plane waves, while useful from the standpoint of the detection and qualitative study of the effect, must be supplemented with a study of the more important case of cylindrical waves (taking into account the finite

dimensions of the electron beam) if quantitative results are to be obtained. (ATD)

46353 MASS COMPOSITION OF THE HIGH-ENERGY IONS BOMBARDING THE CATHODE IN AN ANOMALOUS GLOW DISCHARGE. Bondarenko, A. V.; Lebedev, M. A. (Moscow State Univ.). Zh. Tekh. Fiz., 37: 1074-8(June 1967). (In Russian).

A type MS-4 mass spectrometer was used to record with a resolution of 0.5 mass units the mass spectra over the range from 12 to 65 mass units of the high energy ions in the canal rays from anomalous glow discharges in air, oxygen (containing 4 to 5% nitrogen), and nitrogen (containing 1 to 2% oxygen). The 4-cm-diameter water-cooled steel cathode was provided with a central canal close with a 100-μ-thick copper foil with a 50 to 70-μ diameter opening. The gas pressure in the discharge tube was varied from 0.1- to 0.3-mm Hg; the anode potential, from 2 to 3 kV; and the discharge current, from 5 to 80 mA. The ionic species to which the mass lines in the different spectra were ascribed are (in order of decreasing intensity): for the oxygen discharge, NO^+, O_2^+, O^+, H_3O^+, Cu^+, N^+, H_2O^+, N_2H^+, N_2^+, NO_2^+, Fe^+, and Ni^+; for the oxygen discharge, NO^+, O^+, O_2^+, NO_2^+, N^+, N_2^+, Fe^+, and Ni^+; and for the nitrogen spectrum, N^+, NO^+, O^+, N_2H^+, Fe^+, NH_3^+(?), NH_4^+(?) and NO^+. The differences between these three mass spectra, and between these spectra and spectra recorded by other investigators of the ions in the positive column and in the negative glow, are discussed. (ATD)

46354 IONIZATION-CAUSED COLUMN CONTRACTIONS. I. THE EFFECT OF THE RADIAL VARIATION OF THE NEUTRAL GAS TEMPERATURE. Wojaczek, Karl (Physikalisch-Technisches Institut, Berlin). Beitr. Plasmaphys., 7: 149-65(1967). (In German).

By simultaneous solution of the balance equation for the charge carrier concentration and for the heat of the neutral gas, the radial distribution of the electron density and the neutral gas temperature were calculated for a cylindrical weakly ionized discharge plasma in Ar at average pressure. On the basis of known data of the elementary processes the electrical longitudinal field strength, the electron temperature, the neutral gas temperature in the tube axis and the column concentration were determined as functions of the tube radius R, pressure p, and current intensity i at constant wall temperature T_R. The results are represented with consideration of a general similarity law according to which discharge states with like values of R_p, i/R, and T_R also agree in their characteristic internal indicators. A comparison with the calculated results which were obtained under the assumption of a constant mean gas temperature showed that the radial variation of the temperature leads to a displacement of the discharge characteristic in the direction of small current intensities or smaller field intensities and to a broadening of the discharge orbit. The calculated behavior of the column corresponds qualitatively to the experimental results; significant quantitative deviations of the calculated from the experimental data are shown however at average and smaller values of i/R. (tr-auth)

46355 REDISTRIBUTION OF THE ELECTRON AND ION DENSITIES IN A PLASMA BY THE ACTION OF A STRONG UHF FIELD. Kotsarenko, N. Ya.; Levitskii, S. M.; Fedorchenko, A. M.; Virko, V. F. (Kiev State Univ.). Zh. Tekh. Fiz., 37: 1148-54(June 1967). (In Russian).

The effect of a uhf electromagnetic field on a plasma with finite electron and ion temperatures is discussed. The calculations are based on Maxwell's equations for the field produced by the charges and currents induced in the plasma and the kinetic equations for the motions of the electrons and ions, with collisions taken into account by viscosity terms proportional to constant collision frequencies and the electron and ion temperatures taken into account by diffusion terms. An approximate solution of these equations is found by a successive approximation method. The solution of the linearized equations is taken as the first approximation, and the first approximation solution is substituted into the nonlinear terms to give a set of inhomogeneous linear equations for the second approximation. The second approximation equations are averaged over the time, and the solutions of the time averaged equations are discussed in some detail for the following special cases: a transverse electromagnetic wave in an unbounded plasma; a cylindrical plasma filament carrying a surface E wave; and a magnetized plasma in which both the Larmor frequencies are much higher than the corresponding collision frequencies. It was found that a transverse electromagnetic wave induces a drift of the plasma electrons with respect to the ions, which may give rise to instabilities, and that a uhf field tends to compress a plasma filament toward its axis. The last conclusion was tested experimentally with dc and uhf (500 MHz) discharge plasmas in a 1-cm-diameter glass tube containing saturated mercury vapor at a pressure of 6×10^{-3} mm Hg. The radial distribution of the luminous intensity of the plasma was measured with a photomultiplier and slit system. It was found, in agreement with the theory, that when the discharge currents in the uhf and dc plasmas were so adjusted that the luminous intensities of the plasmas on their axes were equal, the intensity fell off more rapidly with increasing distance from the axis in the uhf plasma than in the dc plasma. (ATD)

46356 PROPAGATION OF ELECTROMAGNETIC WAVES IN SEMICONDUCTORS WHEN THE ELECTRON TEMPERATURE IS NOT A UNIQUE FUNCTION OF THE INCIDENT FIELD AMPLITUDE. Bass, F. G.; Gurevich, Yu. G. (Inst. of Radio Physics and Electronics, Kharkov). Zh. Eksp. Teor. Fiz., 53: 1058-70 (Sept. 1967). (In Russian).

The propagation of strong electromagnetic waves in a semiconductor is investigated in the case when the effective electron temperature is not a unique function of the incident field amplitude. The problem is solved for weak damping of the waves. A qualitative investigation on a model is performed for arbitrary damping. It is shown that under certain conditions the reflection coefficient becomes an oscillating function of the incident field amplitude. The results obtained can easily be applied to a plasma. (auth)

46357 NONLINEARITY AND PARAMETRIC RESONANCE IN A PLASMA. Smirnov, Yu. N.; Frank-Kamenetskii, D. A. Zh. Eksp. Teor. Fiz., 53: 1053-7(Sept. 1967). (In Russian).

Superposition of the magnetic field of a wave on a stationary magnetic field is equivalent to modulating the field. A study of the perturbed trajectories of particles in the modulated field shows that variation of the phase relations of the particle motion and the electric field may result in energy absorption. This effect is of the nature of parametric resonance and appears at frequencies equal to the cyclotron frequency divided by an integer (undertones). The resonance width is inversely proportional to the relaxation time and the height is proportional to the square of the relaxation time. (auth)

46358 DISTRIBUTION OF CAPTURED PARTICLES IN A POTENTIAL WELL IN THE ABSENCE OF COLLISIONS. Gurevich, A. V. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz., 53: 953-64(Sept. 1967). (In Russian).

Collisionless capture of electrons into a region of finite motion due to nonstationarity of a longitudinal electric field is investigated. A kinetic equation is formulated which describes the distribution function of the captured particles during slow (adiabatic) variation of the field. Partial solutions of the equation are obtained and analyzed. Capture in a rapidly increasing field is considered. It is shown that the concentration of captured particles increases with growth of the depth of the potential well slower than $(e\varphi/T)^{3/2}$, i.e. much slower than in the case of an equilibrium Boltzmann distribution. For $e\varphi/T \gg 1$, however, the concentration of captured particles is always greater than that of noncaptured particles. The results are applied to an analysis of nonstationary motions in a plasma. A general kinetic equation is obtained which describes self-similar motion of a rarefied plasma. The structure of a solitary wave (soliton) is investigated by taking into account collisionless electron capture during field buildup. (auth)

46359 PLASMA OSCILLATIONS IN THE PRESENCE OF A PERIODIC LANGMUIR WAVE. Petviashvili, V. I. Zh. Eksp. Teor. Fiz., 53: 917-25(Sept. 1967). (In Russian).

The oscillatory properties of a plasma in the presence of a finite amplitude periodic Langmuir wave are investigated. A dispersion equation for the frequency of long wave oscillations in the plasma is derived by an asymptotic method. It is demonstrated that for a sufficiently large amplitude the Langmuir oscillations build up ion oscillations (drift, ion-sound and others) which are propagated in a direction opposite that of the Langmuir wave. (auth)

46360 NONEQUILIBRIUM LOW-TEMPERATURE PLASMA. I. DISTRIBUTION OF ATOMS ALONG THE LEVELS. Biberman, L. M.; Vorob'ev, V. S.; Yakubov, I. T. (Scientific-Research Inst. of High Temperatures, Moscow). Teplofiz. Vys. Temp., 5: 201-13(Mar.-Apr. 1967). (In Russian).

Energy level distributions of particles of nonequilibrium low-temperature plasmas were analyzed. The theory employed is based on the diffusion approximation developed in relation to the discrete space of bound-state energies. The atom–electron and atom–atom collisions and radiation processes are taken into account. Expressions are developed for the excited-state atomic distribution in a stationary plasma. Theoretical and experimental data are in good agreement. (tr-auth)

46361 TRANSPORT PROCESSES IN A MULTICOMPONENT ASSEMBLY ON THE BASIS OF RECONSIDERED GENERALIZED B–G–K COLLISION MODEL. Srivastava, M. P. (Indian Inst. of Science, Bangalore). J. Indian Inst. Sci., 49: 131-9(July 1967).

Bhatnagar, Gross, and Krook developed a collision model for one component neutral assembly in order to overcome the inherent difficulties of the Boltzmann collision integral. This has been

generalized to an N-component assembly of charged and neutral particles by Bhatnagar and Devanathan. However, for the simplicity of the model, the above mentioned authors have taken the collision cross section to be a constant. In fact the collision cross section is some unknown function of the relative velocity between the particles, as has already been pointed out by Krook and also by Koga. Koga gave some expressions for the cross section, which are linear and exponential function of the square of relative velocity, and calculated the coefficients involved in the model. Choosing the same types of cross section as suggested by Koga, the transport equations were obtained by expanding the distribution functions in generalized Hermite polynomials following Grad. It is found that variable cross section enhances the relaxations times of all physical variables and thereby decreases the electrical conductivity and diffusion coefficients. Also such variable cross section introduces very high anisotropy even in the absence of magnetic field and the magnitudes of the viscosity coefficients in the principal directions are decreased. The bulk viscosity of the plasma is increased apart from introducing anisotropy. Further this model introduces anisotropy in the heat flux tensor also. All the transport properties have been obtained in an earlier paper by Devanathan, Uberoi and Bhatnagar. Modified expressions were obtained for viscosity, electrical conductivity, heat conductivity and diffusion coefficients. (auth)

46362 DRIFT APPROXIMATION FOR A FIELD WITH A NONRESONANT HIGH FREQUENCY COMPONENT. Klima, R. (Inst. of Plasma Physics, Prague). Zh. Eksp. Teor. Fiz., 53: 882-5(Sept. 1967). (In Russian).

The effect of a hf field on the drift of a particle is considered. The field frequency is assumed to not be very close to the cyclotron frequency. It is shown that the averaged force due to the high frequency field acting on the particle reduces to the gradient of a certain effective potential. Under similar assumptions a hydrodynamic equation for smooth motion is derived in which collisions are also taken into account. (auth)

46363 TITANIUM COAXIAL GUN. Blinov, P. I.; Cheremnykh, P. A. (Inst. of Atomic Energy, Moscow). Teplofiz. Vys. Temp., 5: 388-9(Mar.-Apr. 1967). (In Russian).

Descriptions are given of the design and performance of a Marshall gun employing titanium electrodes saturated with 30 to 50% deuterium. The gun was designed for injection in the magnetic trap in the TH-1 installation. The diameters of the external and internal electrodes are 14 and 5 cm, and the lengths are 12 and 5 cm, respectively. In order to develop a uniform discharge, three titanium-tipped electrodes are symmetrically distributed on the external electrode. In order to fill up a 16-cm chamber the plasma gun was placed behind the magnetic mirror where the magnitude of the magnetic field was close to the field of the center of the trap. (R.V.J.)

46364 CALCULATIONS OF HEATED CONDENSED PARTICLES IN A PLASMA JET. Panfilov, S. A.; Tsvetkov, Yu. V. (Inst. of Metallurgy, Moscow). Teplofiz. Vys. Temp., 5: 294-301(Mar.-Apr. 1967). (In Russian).

An approximate solution for the mean mass temperature of argon jets, with an injected powder substance, was obtained during calculations with the heat exchange equation using an analog computer. The solution is presented as a temperature function of time. (tr-auth)

46365 THEORY OF STATISTICAL EQUILIBRIUM OF PARTICLE MIXTURES. Artym, R. I. (Moscow Power Engineering Inst.). Teplofiz. Vys. Temp., 5: 259-64(Mar.-Apr. 1967). (In Russian).

Equations for an ionized gas in Debye-Hueckel approximation were derived on the basis of integral-differential equations for determining correlative functions of the second order. (tr-auth)

46366 COMPUTATION OF LITHIUM PLASMA EQUILIBRIUM PROPERTIES. Potapov, A. V.; Babkin, G. V. Teplofiz. Vys. Temp., 5: 246-53(Mar.-Apr. 1967). (In Russian).

Thermodynamic characteristics of lithium vapor (composition, specific enthalpy, specific heat capacity at p = const. and v = const., heat capacity ratio at constant pressure and volume, apparent molecular weight, and the velocity of sound) and their plasma parameters (plasma frequency, Debye radius, the magnitude of ln A, the electron mean free path length, and critical electric field intensity) were investigated. The characteristics and maximum variations of these magnitudes were found as functions of temperature and pressure. It was found that the equilibrium lithium plasma is characterized by a considerable difference of temperature for the lithium single and double ionization, indicating a wide temperature range of singly ionized lithium vapors. (tr-auth)

46367 COMPOSITION AND THERMODYNAMIC PROPERTIES OF HIGHLY IONIZED GAS MIXTURES. Samuilov, E. V. (Moscow Power Engineering Inst.). Teplofiz. Vys. Temp., 5: 214-18(Mar.-Apr. 1967). (In Russian).

Simple equations are developed for the ionization and thermodynamic functions of gas mixtures of various-type atoms and highly ionized atoms. All magnitudes are expressed by Slater-type atomic constants. (tr-auth)

46368 ON THE STATIONARY STATE OF PLASMA IN A MAGNETOSTATIC AND A POTENTIAL FIELD. I. Klima, R. (Inst. of Plasma Physics, Prague). Czech. J. Phys., 17: 675-85(1967).

An analysis is made in the "guiding center" approximation of the stationary state of a collisionless plasma in an inhomogeneous magnetostatic field in the presence of an electric field $E_0 = -\nabla V$ and some additional field acting on the longitudinal motion of electrons and ions by the effective potentials W_e and W_i. The following are derived in particular: (1) the distribution functions of the quasi-neutral plasma with Maxwellian distribution of the longitudinal velocities; (2) the stationary perturbations of arbitrary distribution function caused by changing the effective potentials by $\delta W_{e,i}$; and (3) formulae describing the concentration in some cases with an incomplete Maxwellian distribution. (auth)

46369 FIRST-ORDER COUPLED DIFFERENTIAL EQUATIONS FOR WAVES IN INHOMOGENEOUS WARM MAGNETOPLASMAS. Kalluri, D.; Unz, H. (Univ. of Kansas, Lawrence). Proc. IEEE (Inst. Elec. Electron. Eng.), 55: 1620-1(Sept. 1967).

The first-order coupled differential equation for waves in gyrotropic inhomogeneous warm magnetoplasmas are derived for the case where the plasma parameters $N_0(z)$, $T_0(z)$, $v(z)$, and $H_0(z)$ vary in the z direction only. In this form they are well suited for solution on a digital computer by the Runge-Kutta method. (auth)

46370 VAN DER WAALS-WIDTH OF NEUTRAL SILICON LINES IN ARGON. Feldhausen, Hartmut; Kusch, Hans Juergen (Univ., Kiel). Z. Astrophys., 67: 123-30(1967). (In German).

Width and shift of 15 Si I lines by van der Waals interaction with neutral argon atoms was measured using a high-pressure arc between a silicon anode and a carbon cathode in an argon atmosphere. The results are compared with theoretical estimates and presented in a table. (auth)

46371 STUDY OF AN INDUCTIVELY COUPLED PLASMA. Armstrong II, Donn Reynolds. Minneapolis, Univ. of Minnesota, 1966. 94p.

Thesis.

A design model based on energy balance considerations was developed for an induction-coupled plasma which can be used for high-temperature chemical reactions. The model accounts for three mechanisms of energy transfer, an induction energy input and two heat loss rates, one involving radiation and the other conduction and convection. To test the model an axial flow argon plasma with diameter of order 1 cm was obtained in the frequency range from 15 to 30 MHz and at a peak power of 2 kW. This plasma was used to determine an empirical constant in the model and test predictions of the model. Power was measured calorimetrically. Radiation was measured with an axial radiometer and rf current was measured using a toroidal sensing coil and hot-wire ammeter. The model predicted existence conditions and division of power between radiation and conduction-convection within ±20% of the powers for the argon plasma. A qualitative description of a second type of plasma whose length is much greater than its diameter is included. (Disser. Abstr.)

46372 NONLINEAR STUDY OF BEAM PLASMA AMPLIFICATION. Poeschel, Robert Leslie. Pasadena, Calif., California Inst. of Tech., 1967. 122p.

Thesis.

The interaction between an electron beam and the plasma oscillations it excites in traversing a plasma region effectively changes the magnitude and direction of the force between beam electrons. This effect has been studied theoretically and experimentally by computing and observing beam electron velocities and phases for a beam which is initially velocity modulated at frequency ω and allowed to drift through a plasma filled region of plasma frequency ω_p. When $\omega > \omega_p$ the force between electrons is repulsive and effectively increases in magnitude as ω approaches ω_p. When $\omega < \omega_p$, the force between electrons becomes a force of attraction, to within a given interelectron spacing, and the maximum effect is also at the resonance conditions $\omega \sim \omega_p$. This property could be used to improve the efficiency of electron bunching in a klystron type amplifier by filling the drift space with a plasma of appropriate density. The beam behavior is studied theoretically by computing in an exact, nonlinear manner, the trajectories of a disc

model electron beam which traverses a linear, dielectric model plasma. The parameters varied are the beam space charge conditions (beam current), the degree of initial velocity modulation, and the ratio of modulation frequency to plasma frequency (ω/ω_p). Computations show that it is possible to bunch the beam electrons to within 85% of delta function bunching under some beam and plasma conditions. The electron beam behavior is studied experimentally by observing the beam electron velocity phase distribution with a crossed-field velocity analyzer, and observing the beam current waveform (density-phase distribution) using a wideband sampling oscilloscope. Experimental results show essentially the same beam behavior as predicted by the computations with some differences which are attributed to variation in the plasma density along the beam path. (Disser. Abstr.)

46373 EXCITATION OF CYCLOTRON-HARMONIC NOISE IN A BEAM-GENERATED PLASMA. Roberts, Michael. Ithaca, N. Y., Cornell Univ., 1966. 242p.

Thesis.

Deliberate, controlled excitation of a special class of electrostatic waves was achieved in a pulsed electron-beam-generated hydrogen plasma. Microwave drive signals near the electron gyro frequency were applied to the electron beam in the form of transverse electric fields. With a change in the magnetic field, the beam plasma system could be made stable or unstable with respect to the emission of narrow-band, cyclotron-harmonic radiation. In the stable mode, the rf drive fields, applied with a bifilar helix coupler, excited cyclotron harmonic waves propagating across the magnetic field inducing narrow-band radiation. For the radiation to be observable, the Doppler frequency shift condition had to be satisfied by appropriate values of beam voltage, drive coupler pitch, magnetic field, and drive frequency. With the system in the unstable mode, the rate of plasma generation was increased, using cyclotron frequency drive fields which resulted in radiation appearing earlier (at a given receiver sensitivity) in the beam voltage pulse. Under the same conditions, the frequency of the self-excited noise was shifted by enlargement of the plasma electron orbit caused by sufficiently strong drive fields. Whether the system was in the stable or unstable mode, noise could only be measured when the density was sufficiently high that the receiving frequency was less than the upper hybrid frequency. These stimulated noise emissions are closely related to the high-harmonic, nonthermal radiation at microwave frequencies reported in recent years. (Disser. Abstr.)

46374 DENSITY MATRIX FORMALISM AND THEORY OF RELAXATION PHENOMENA. Rau, Jayaseetha. Waltham, Mass., Brandeis Univ., 1962. 90p.

Thesis.

The most general dynamical law for a quantum-mechanical system with a finite number of levels is formulated. A fundamental role is played by the so-called "dynamical matrix" whose properties are stated. A necessary and sufficient criterion for distinguishing dynamical matrices corresponding to a Hamiltonian time dependence is formulated. The non-Hamiltonian case is discussed in detail. A method is developed for generating relaxation by introducing a fundamental interval τ and a stirring hypothesis. The application to spin and harmonic oscillator systems is discussed in some detail. Equations similar to phenomenological Bloch equations are derived in the case of spin systems. The relaxation times obtained by the application of the theory are not only proportional to the strength of interaction but also to the fundamental interval τ which plays an important role in the theory. It is shown in the case of a harmonic oscillator system, an initial Boltzmann distribution relaxes to a final equilibrium Boltzmann distribution through a sequence of transient Boltzmann distributions. (Disser. Abstr.)

Production of Plasma

46375 THE NATURE OF IONIZATION IN A DISCHARGE CESIUM PLASMA. Morgulis, N. D.; Korchevoi, Yu. P.; Lukashenko, V. I. (Kiev State Univ.). Ukr. Fiz. Zh., 12: 1362-74(Aug. 1967). (In Russian).

The nature of ionization is considered in a plasma of a low voltage arc discharge in cesium vapors at a pressure of 0.03 to 0.3 mm Hg in the electron concentration region $n_e = 10^{11}$ to 10^{15} cm^{-3}. Probe measurements are carried out on the plasma parameters and ion current on the wall, characterizing ionization capacity of electrons. Various probe and spectral methods are considered for determining the electron temperature of a cesium plasma T_e; the measured effective cross sections of excitation and ionization of cesium atoms are used. (auth)

46376 ANALOGY BETWEEN PROCESSES IN METALS UNDER PULSED DISCHARGE AND UNDER A CONCENTRATED LASER BEAM. Grechikhin, L. I.; Min'ko, L. Ya. (Inst. of Physics, Minsk). Zh. Tekh. Fiz., 37: 1169-72(June 1967). (In Russian).

The results of a detailed experimental investigation of the nature of processes in disintegrated materials under pulsed discharge and under a neodymium-glass laser are discussed. In both cases, the processes were found to be of thermodynamic nature, while the nature of disintegration depends on the concentration of energy. For instance, at beam energy concentrations of 10^8 wt/cm^2, an explosive evaporation, similar to the disintegration of the cathode in a pulsed discharge, takes place. At 10^7 wt/cm^2, the evaporation process resembles that of an arc discharge or of an anode under pulsed discharge. The disintegration in both cases is accompanied by plasma jets composed of metal vapors, particles, and liquid droplets, emerging at right angles to the surface. The jetting is intermittent, due to the nonstationary nature of the energy liberated from different points of the surface. The intermittence, in the case of a laser beam, stems from the pulsations of the laser beam and the nonuniformity of intensity distribution over its cross section. In case of discharge, the intermittence, is caused by fluctuations of the current density due to migration of the discharge channel over the electrodes. The jets display a dark zone which corresponds to the underexpansion of the supersonic plasma. The adjacent zone of intense luminosity in the jet corresponds to the compression shock. These characteristics, combined with the perpendicularity of propagation relative to the surface under any angle of impact, can be explained by the hydrodynamic nature of the process. The physical condition of the plasma, shown earlier with respect to laser beam effects is thermal in character. The laser beam induces plasma temperatures of 5,000 to 10,000°K, with particle concentrations of the order of 10^{15} to 10^{17} per cm^3. (ATD)

46377 LASER PLASMA PRODUCTION: A NEW AREA OF PLASMADYNAMICS RESEARCH. Meyerand, Russell G. Jr. (United Aircraft Research Labs., East Hartford, Conn.). AIAA (Amer. Inst. Aeronaut. Astronaut) J., 5: 1730-7(Oct. 1967).

The basic theory of gas breakdown produced by optical radiation is discussed, and the absorption of laser energy in the resultant plasma described. Theories of the dependence of gas breakdown and energy absorption on gas pressure, gas species, and optical strength are discussed. (M.O.W.)

46378 HOT-SHOT GAS SOURCE FOR PULSED MHD ACCELERATOR. Grabowsky, W. R.; Durran, D. A.; Spencer, D. J. (Aerospace Corp., El Segundo, Calif.). AIAA (Amer. Inst. Aeronaut. Astronaut) J., 5: 1811-17(Oct. 1967).

A hot-shot-type nitrogen source has been developed which will produce the desired gasdynamic properties required for pulse-type MHD accelerator experiments. The source stagnation conditions are T_s = 9000°K and p_s = 1400 atm. Usable flow time of the source is approximately 3 msec, and the source pressure decay rate is 15% $(msec)^{-1}$. A real-gas expansion (N_2) can be made for typical gasdynamic parameters which agrees with measured channel values within experimental accuracy by accounting for contamination and seed material (KN_3). Evidence presented supports the conclusion that highly ablative liners (Delrin, Teflon, etc.) considerably degrade the performance of high-pressure, high-temperature discharge devices. BN liners have an average contamination of 4% by weight; lower contamination is probably possible with lower stagnation temperatures. (auth)

Stability of Plasma

Refer also to abstract 46332.

46379 (N-67-18712) EFFECT OF COULOMB COLLISIONS ON CONTRASTREAMING PLASMAS. Buti, B.; Trehan, S. K. (National Aeronautics and Space Administration, Greenblet, Md. Goddard Space Flight Center). [1965]. 44p. (NASA-TM-X-57286). CFSTI.

The instability of contrastreaming plasmas is investigated accounting for the Coulomb collisions via the Fokker–Planck coefficients in the Boltzmann equation. The dispersion relation, obtained on the assumption that the Coulomb collisions are weak, is solved on the additional assumption that the phase velocity of the wave is much larger than the mean thermal velocity of the particles. It is found that while the temperature has the effect of increasing the maximum wavenumber below which the plasma is unstable, and the collisions have no effect on this wavenumber. The growth rate of maximum instability decreases, compared to its value for a cold plasma, with thermal motions and increases when the collisions are taken into account. (auth) (STAR)

46380 EFFECT OF THE DEPTH OF PENETRATION OF THE MAGNETIC FIELD OF CIRCULAR POLARIZATION ON THE PLASMIC CYLINDER STABILITY. Gubarev, V. F.; Merkulov, V. I. (Kiev Inst. of Cybernetics). Ukr. Fiz. Zh., 12: 1345-52(Aug. 1967). (In Russian).

Magnetohydrodynamic stability was investigated of a cylindrical gas conductor of finite conductance σ which is kept in vacuum by the pressure of the alternating magnetic field of circular polarization. The depth of magnetic field penetration into the plasma cylinder is determined by the value $\delta = 1/\sqrt{\sigma\omega}$ where ω is the field circular frequency. The investigation was carried out for different δ, supposing that the perturbation frequency is much higher than that of field rotation ω. By means of the energetic principle the problem was reduced to finding the minimizing perturbation within the limits of a diffusion layer estimated by computer. It is shown that the region of unstable perturbations greatly expands at the cost of a short-wave spectrum with the decrease of the depth of the field penetration, i.e., with the decrease of the skin-layer thickness. (auth)

46381 IONIC CYCLOTRON WAVES IN A MAGNETIC WELL. Brossier, Philippe (EURATOM–CEA, Fontenay-aux-Roses, France). Compt. Rend., Ser. A and B, 264: 1787-90(June 26, 1967). (In French).

A resonant instability is developed in a plasma confined in a magnetic well. The study of the wave permits a comparison with the instabilities theoretically predicted. (tr-auth)

46382 PLASMA INSTABILITY IN THE ELECTRIC FIELD OF AN ION-CYCLOTRON WAVE. Sizonenko, V. L.; Stepanov, K. N. (Inst. of Physics and Tech., Kharkov). Nucl. Fusion, 7: 131-5(Sept. 1967).

The stability of a collisionless plasma is investigated in which the ions are moving relative to the electrons at right angles to the applied magnetic field, under the influence of the electric field of an ion-cyclotron wave, with a velocity $\tilde{u}_i$ that is less than or commensurate with the thermal velocity of the ions v_i. A study was made of the excitation of longitudinal electrostatic oscillations with frequency and growth rate significantly greater than the gyrofrequency of the ions, but significantly less than that of the electrons, and with a wavelength significantly less than that of the ion-cyclotron wave. It is shown that, when the ion temperature T_i is significantly higher than the electron temperature T_e, electron-acoustic oscillations are excited in the plasma. The excitation of these oscillations by resonance ions is possible even when $u_\perp \ll v_i$. When $T_e \gg T_i$ ion–acoustic oscillations are excited in the plasma, the buildup of these oscillations by the ions being the result of absorption by resonance electrons. When $T_e \gtrsim T_i$ oscillations are excited if the velocity of the ion beam u_i is somewhat greater than the thermal velocity of the ions. When $T_i \gg T_e$ the reactive effect of the oscillations causes the function representing resonance ion distribution in the beam direction to level off and form a plateau. When $T_e \gg T_i$ the unstable ion–acoustic oscillations spread the resonance electron distribution function, which is equivalent to electron heating, and slow down the ion beam. (auth)

46383 CYCLOTRON INSTABILITY OF A PLASMA IN MAGNETIC MIRROR MACHINES. Davydova, T. A.; Dnestrovskii, Yu. N.; Kostomarov, D. P. (Moscow State Univ.). Nucl. Fusion, 7: 123-9(Sept. 1967).

The cyclotron instability is considered in a homogeneous plasma with anisotropic nonmonotonic ion distribution in velocity space. In the plane of the parameters $\nu = \omega_{0e}^2/\omega_i^2$ and $\tau = \epsilon_\perp/\epsilon_\parallel$ (where ω_{0e} is the plasma frequency of the electrons, ω_i is the Larmor frequency of the ions, $\epsilon_\perp$ and $\epsilon_\parallel$ are the transverse and longitudinal energy of the ions respectively) regions are constructed by numerical methods which correspond to the unstable states of a plasma at cyclotron resonances of different orders. The dependence of these regions on electron temperature, the dimensions of the trap, and the width of the ion transverse-velocity distribution peak are studied. The stability of a plasma in machines of the Ogra-2 type is discussed. It is shown that the results of recent experiments on the Phoenix device aimed at suppressing cyclotron instability cannot be explained by broadening of the ion distribution peak. To stabilize the oscillations in this machine it is sufficient to increase the temperature of the electrons to 30 to 50 eV, which is apparently what happens in this experiment. (auth)

46384 INHOMOGENEOUS DEVELOPMENT OF A PLASMA THROUGH QUASI-LINEAR THEORY. Bloomberg, H. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Nucl. Fusion, 7: 99-109(Sept. 1967).

A quasi-linear perturbation expansion is used to study the evolution of a localized disturbance introduced in a homogeneous plasma characterized by a distribution function having a small "bump" on its tail. For this problem first-order theory of the Vlasov equation predicts the development of growing waves. The curtailment of this instability through a plateau development in v space is given through the second-order corrections. During the curtailment process the distribution function develops weak time and space dependence. There is shown an energy transfer balance between the growing waves and the particles with bump velocity which are part of the "background" distribution function and those which are second order in the "disturbance" distribution. Comparison with earlier quasi-linear theory is made. (auth)

46385 PERSISTENCE OF MHD-STABILITY IN THE TWO-FLUID MODEL. Schram, P. P. J. M. (Univ. of California, Los Angeles. Univ. of California, Berkeley); Tasso, H. Nucl. Fusion, 7: 91-8(Sept, 1967).

A general proof is given that all static equilibria without volume currents which are stable according to magnetohydrodynamics (MHD) remain stable in the two-fluid model, if resistivity and electron inertia are neglected. Therefore the Hall term in Ohm's law can only have stabilizing effect, if any effect at all. The result is valid for finite beta and arbitrary geometry, whether a wall or vacuum surrounds the plasma. As a special example the cylindrical pinch with surface currents is investigated in detail. (auth)

46386 QUASILINEAR THEORY OF APERIODIC INSTABILITIES. Perel'shtein, E. A. Zh. Tekh. Fiz., 37: 1177-80 (June 1967). (In Russian).

This theory involves an asymptotic equation to determine the background distribution function describing the diffusion process in velocity space as a function of the energy of the electromagnetic field of the developing instability. This equation is to be solved under the condition that the distribution function reduce to a given initial distribution function when the energy of the instability is zero. The equation is solved for an initial Maxwell distribution and an initial "step" distribution ($f(v) = 0$ for $|v| > a$, f = const. for $|v| < a$) after the distribution has been somewhat smoothed by diffusion (the approximations employed in the quasi-linear theory do not permit the step function to be used directly). It is found that these two initial distributions lead to widely different solutions, and it is concluded that even qualitative conclusions drawn from the quasi-linear theory of aperiodic instabilities depend essentially on the choice of the initial distribution function. (ATD)

46387 MULTIPLASMON DECAY INSTABILITIES OF A TURBULENT PLASMA. Oraevskii, V. N.; Tsytovich, V. N. (Inst. of Physics, Kiev). Zh. Eksp. Teor. Fiz., 53: 1116-24 (Sept. 1967). (In Russian).

It is shown that the interrelationship of various three-plasmon interactions (one or two waves simultaneously participate in at least two three-plasmon interactions) may require an appreciable re-evaluation of the efficiency of some nonlinear processes previously obtained and lead to qualitatively new effects. Thus due to the interrelationship between three-plasmon interactions, multiplasmon decay instabilities may arise already in the first order in perturbation theory with respect to the number of quasi particles of the turbulent state. A characteristic feature of multiplasmon instabilities of the indicated type is the excitation of frequencies which may be smaller or larger than the initial ones. The influence of dissipative effects on multiplasmon decay processes is investigated. It is shown, in particular, that even for weak coupling all coupled waves may grow, with a linear instability increment of one of them. Smallness of the coupling constants only defines the relation between the intensities of the bound waves. (auth)

46388 CONDITION FOR FLUTE INSTABILITY OF A TOROID-GEOMETRY PLASMA. Shafranov, V. D.; Yurchenko, E. I. Zh. Eksp. Teor. Fiz., 53: 1157-66(Sept. 1967). (In Russian).

The Suydam criterion is extended to the case of toroid geometry. The problem is solved in two ways. In one flute disturbances are considered which correspond to large azimuth numbers ($m \gg 1$). In the second, use is made of a general criterion due to Solovyov for instability of disturbances localized in the direction of the normal to the magnetic surfaces. Both methods yield the same criterion which differs from that previously obtained by Kadomtsev and Pogutse in being simpler and more compact. (auth)

Shielding

Refer also to abstracts 46629, 46643, and 46712.

46389 (AED-C-33-03) BIBLIOGRAPHIEN ZUR KERNFORSCHUNG UND KERNTECHNIK. SEKTION 33. ABSCHIRMUNG RADIOAKTIVER STRAHLUNG IN DER KERNPHYSIK. (Bibliographies in Nuclear Science and Technology. Section 33. Shielding of Radioactive Radiation in Nuclear Physics). Schmidt, A. (comp.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). July 1967. 140p. (In German and English). Dep.

Approximately 450 references are included on accelerator, reactor, space vehicle, structure, container beta, gamma, neutron, and high-energy charged-particle shielding. Titles only are given, but most references have NSA citations. (M.H.R.)

46390 (CEA-Bib-95) L'EFFET MULTIPHOTONIQUE. (The Multiphoton Effect). Faugeras, Paul-Etienne (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). July 1967. 35p. (In French). Dep.

Since the appearance of high-power lasers, a new interaction process between radiation and matter is observed: the multiphoton effect, in which not less than two photons interact simultaneously with an atom. The theory of this phenomenon, which comes from the frame of perturbation theory in quantum mechanics, is briefly described and the main characteristics of multiphoton processes are deduced from it. The experimental work in this field is then reviewed, classing it in three categories: simultaneous absorption of several photons, processes with emission of photons, and ionization by multiphotonic effect. (auth)

46391 (HASL-185) LEGENDRE, TSCHEBYSCHEFF, AND HALF-RANGE LEGENDRE POLYNOMIAL SOLUTIONS OF THE GAMMA RAY TRANSPORT EQUATION IN INFINITE HOMOGENEOUS AND TWO MEDIA PLANE GEOMETRY. Bennett, Burton G.; Beck, Harold L. (New York Operations Office (AEC), N. Y. Health and Safety Lab.). Aug. 1967. 68p. Dep. CFSTI.

The polynomial expansion matrix equation method for obtaining semi-analytical solutions of the one-dimensional Boltzmann equation has been extended for use with full range Legendre polynomials (P3, P5, P7), Tschebyscheff polynomials (T3, T5) and half-range Legendre polynomials (DP1). Each of the polynomial approximations has been used to calculate the differential energy spectra and angular distributions for various gamma-ray source distributions in several scattering media. Comparisons of the infinite medium results were made with the exact calculations at the source energy, a careful experimental measurement of the energy spectrum from a 0.662-MeV point isotropic source in an effectively infinite water medium, the differential energy spectra and buildup factors from Goldstein and Wilkens' moments method calculations, and with the angular distributions from a moments method calculation for a 1-MeV plane isotropic source. The comparisons of these results show good agreement. (auth)

46392 (N-67-18240) [STUDY OF HIGH ENERGY NUCLEAR REACTIONS AND SPACE RADIATION SHIELDING]. Final Technical Report, March 1, 1965-August 31, 1966. Shen, B. S. P. (New York Univ., N. Y.). Sept. 20, 1966. 23p. (NASA-CR-81796). CFSTI.

Spatial distribution measurements of the activation products fluorine-18 and sodium-24 were made on aluminum foil in a plexiglass target. The target was bombarded in two separate irradiations by a beam of 2.2- and 2.9-GeV protons. Results showed that measured activities increased with depth and attained a broad plateau near the downstream end of the target. Also determined were energy distributions of fast neutrons emitted from a thin target of carbon bombarded by 1-GeV protons. (STAR)

46393 EXPERIMENTAL STUDIES ON GAMMA-RAY DOSE RATES FROM A ^{60}Co CYLINDRICAL SOURCE. Furuta, Yutaka (Japan Atomic Energy Research Inst., Tokyo); Kanemori, Yoshihiko. Nucl. Sci. Eng., 30: 261-7(1967).

Gamma-ray dose rates from a ^{60}Co cylindrical source were obtained experimentally in the radial direction at the half-height of the source. The concept of the dose buildup factor was introduced for a volume source. The dose buildup factor for a cylindrical source, which is represented as a function of the distance between source and detection point, has a value of about five at the point nearest to the source surface. The factor then decreases rapidly, passes through a minimum value, and approaches a constant value. These features were analyzed experimentally with a line and a disk source. An empirical formula for the dose buildup factor is proposed, which agrees with the experimental values to within about ±15%. (auth)

46394 STUDY OF THERMAL NEUTRONS IN SHIELDS CONTAINING DUCTS BY SOURCE-SEPARATION TECHNIQUES. Channon, F. R.; Seale, R. L. (Univ. of Arizona, Tucson). Nucl. Sci. Eng., 30: 242-60(1967).

The behavior of thermal neutrons in a water shield containing ducts was studied experimentally and compared with theoretical models. In addition to measuring the total flux, a source separation technique was used to isolate the various flux components, which are: (1) direct flux, uncollided neutrons that enter the duct mouth; (2) scattered flux, collided neutrons that enter the duct mouth; and (3) penetration flux, collided neutrons that originally enter the shield. Duct diameters from $1\frac{1}{8}$ to 4 in. were considered. The shield absorption properties were altered by dissolving various amounts of boric acid in the water. The duct cross-sectional shape was changed by partially flooding the interior of the duct. The experimental results indicated that the direct flux is inversely proportional to distance squared. For sufficiently long ducts, the direct flux is nearly the total flux. For shorter ducts, either the scattered flux or penetration flux may produce the largest contribution to the total flux. Each of these components peak near the duct mouth and then attenuate more rapidly than the direct flux. Successful calculational models were developed for each of the flux components. These permitted determination of the total flux to within a factor of 1.3 at distances greater than two or three duct diameters from the mouth. (auth)

Solid-State Physics

Refer also to abstracts 45070, 45071, 45394, 45925, 45926, 46173, 46174, 46638, 46640, 46647, and 46648.

46395 (AD-650122) STUDIES OF CENTERS PRODUCED IN SAPPHIRE AND RUBY BY GAMMA RADIATION. Final Scientific Report (Part III), October 8, 1965-December 7, 1966. Philbrick, Charles R. (North Carolina State Univ., Raleigh. School of Physical Sciences and Applied Mathematics). Contract DA-01-021-AMC-13339(Z). 112p. CFSTI.

Centers produced by the γ irradiation of laser crystals are known to strongly affect laser characteristics. The centers produced by gamma radiation in sapphire and ruby crystals were studied using several experimental techniques. The optical absorption of γ-radiation-induced center bands was studied using plane polarized light to investigate the optical properties along axes perpendicular and parallel to the c axis. This technique permits determination of the anisotropy of the radiation-produced centers. The detailed studies of the optical center bands contributed to the identification of the various components of the center band structure. In addition, the results of studies of glow curve measurements, thermoluminescent emission spectra, electrical conduction and step annealing are reported and discussed for the case of centers produced in ruby and sapphire crystals by gamma radiation. Also, the thermal activation energies of the traps associated with the sapphire centers were calculated by three different methods and found to be in good agreement. (auth)

46396 (EUR-3621e(Pt.1)) INELASTIC NEUTRON SCATTERING AND LATTICE DYNAMICS OF METALS IN QUASI-ION APPROXIMATION. Krebs, K.; Hoelzl, K. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). July 10, 1967. 25p. Dep.

The inelastic neutron scattering method offers the best and most direct way to measure phonon dispersion curves. A model is presented which describes the experimentally observed dispersion curves for metals as arising from a screened interaction between quasi-ions. The form factors of the quasi-ions in relation to their effective potentials —obtainable by nonlinear least square fitting to neutron data or approximatively to elastic constants —are basic quantities for the calculation of thermodynamic and electronic properties of real metals. The pertinent formulas for the model and some of its representative applications are developed and collected. (auth)

46397 (IS-T-155) A MAGNETIC RESONANCE STUDY OF THE VANADIUM-CHROMIUM SYSTEM AND OF THE NEEL TEMPERATURES OF THE CHROMIUM-RICH ALLOYS. Graham, Thomas Peter (Ames Lab., Iowa). Aug. 1967. Contract W-7405-eng-82. 139p. Dep. CFSTI.

Thesis.

The magnetic resonance of ^{51}V was studied throughout the composition range of the bcc vanadium-chromium alloys. The ^{53}Cr resonance was studied in pure chromium metal and a few of the dilute chromium alloys. On the basis of a rigid two-band model, the composition dependence of the ^{51}V Knight shifts was shown to be due to the interplay of the orbital and the negative core polarization contributions to the shift. The spin-lattice relaxation time of ^{51}V in the alloys was found to depend primarily on the density of d-electron states at the Fermi surface. The ^{53}Cr Knight shift was found to be predominantly orbital in origin. Evidence was found for the occurrence of quadrupole interactions in this system. This was based on measurements of the resonance intensity and line width supplemented by the observation of narrow spin-echo widths. The effect of impurity screening on the quadrupole interactions and line widths is qualitatively discussed. The Neel temperatures of chromium and of a series of dilute vanadium-chromium alloys were measured. The extinction of the resonance at the antiferromagnetic transition was used as the criterion to determine these temperatures. The Neel temperatures decreased rapidly as the vanadium concentration was increased. These temperatures extrapolate to zero Neel temperature at a vanadium concentration of about 3.5%. These results are discussed in terms of the current theory of antiferromagnetism in chromium. (auth)

46398 (IS-T-175) THE DE HAAS-VAN ALPHEN EFFECT AND THE FERMI SURFACE OF IRON. Panousis, Peter Theodore (Ames Lab., Iowa). Aug. 1967. Contract W-7405-eng-82. 125p. Dep. CFSTI.

Thesis.

A high-speed digital recording system has been incorporated into the impulsive-field de Haas–van Alphen experiment which, when used with a specially devised computer program, provides a significant increase in the frequency resolution of this experiment and at the same time enormously decreases the time required for analysis of the results. This data recording and analysis system was used to study the de Haas–van Alphen effect in iron whiskers with impulsive fields of up to 220 kG. The results have been interpreted in terms of two sets of surfaces, one set for spin-up electrons, which is in fair agreement with band calculations, and another set for spin-down electrons, which differs considerably from the surface predicted by band calculations. This model has been shown to account for the results of recent magnetoresistance and Hall effect measurements in iron. (auth)

46399 (NYO-2391-45) EFFECTS OF IMPURITIES ON LATTICE VIBRATIONS. A MODEL CALCULATION INCLUDING MASS AND FORCE CONSTANT CHANGES. NEUTRON SCATTERING. Lakatos, Katja (Cornell Univ., Ithaca, N. Y. Materials Science Center). June 1967. Contracts AT(30-1)-2391; AT(30-1)-3699. 265p. (NYO-3699-8). Dep. CFSTI.

Thesis.

The effects of a low concentration of impurities on the vibrational properties of cubic monatomic harmonic lattices were studied. The problem is formulated in terms of a slow-neutron scattering experiment. The model used allows for both the mass of the impurity and the force constants binding it to its nearest, and in some cases next nearest, neighbors in the lattice to be different from those of a host atom. Numerical computations are performed on Al containing heavy impurities, with force constants treated as parameters that are varied over a wide range. The results are compared to those obtained from Taylor's model, which only allows for mass change. It is found that the resonance characteristics of the impurity are much more sensitive to force-constant changes than to mass change. When mass and forces change in the same direction (e.g., heavy impurity, weak force constants), there is only one impurity resonance mode. When the changes are in opposite directions, two resonances, or one resonance and one localized mode, appear. It is also found that when force-constant changes occur, the neighbors of the impurity share much more in the resonance motion than when only a mass change occurs. The shift and broadening of phonons is more difficult to study with mass and force-constant changes than with only a mass change. In the latter case, these quantities depend only on frequency, while in the former, they also depend on wave vector and branch index. Force-constant changes also cause branch mixing except for phonons propagating along high-symmetry directions. In general, shift and broadening of phonons are greater when force-constant changes occur. The effect of impurity–impurity correlations has been studied in the mass change model. The resulting expressions for shift and broadening of phonons are very complicated, and no numerical computations were performed with them. (auth)

46400 (UCB-34P20-T-1) NOTES ON DYNAMIC PROTON POLARIZATION. Jeffries, C. D. (California Univ., Berkeley. Dept. of Physics). Sept. 23, 1966. Contract AT(11-1)-34. 42p. Dep. CFSTI.

Rate equations are developed for the polarizations of an electron-nuclear spin system consisting of Nd^{3+} spins S surrounded by proton spins I within the diffusion barrier and many distant proton spins I', appropriate to 1% Nd in $La_2Mg_3(NO_3)_{12} \cdot 24H_2O$. A shell-of-influence model, modified to include diffusion and undesirable magnetic impurities, is used to predict a unique proton relaxation rate, which is found to be in agreement with measurements, in magnitude and in dependence on field and temperature. The coupled rate equations for dynamic proton polarization by saturation of forbidden I_zS_- microwave transitions are discussed. When the relative abundance of protons to Nd^{3+} ions is correctly taken into account, the microwave power required to saturate the proton polarization is found to agree with the observations. Rate equations are developed and are solved for the case of dynamic polarizations in the presence of a phonon bottleneck. In the typical case of 1% Nd: LaMN at 4mm, the bottleneck has only a small effect on the proton polarization and saturation behavior. (auth)

46401 (UUIP-537) CALCULATION OF THE ELASTIC CONSTANTS OF NaF. II. EFFECT OF SCALING. Pettersson, G.; Vallin, J.; Calais, J.-L.; Mansikka, K. (Uppsala Univ. (Sweden). Inst. of Physics). Apr. 1967. 19p. Dep.

The cohesive energy, the lattice distance, the compressibility, and the elastic constants of NaF were calculated by Loewdin's quantum mechanical method. The effect from the crystal field on the relatively loosely bound 2p electrons of the F^- ion was taken into account by radial scaling of their orbitals. In determining the repulsive energy, interactions between nearest neighbors as well as next nearest (negative) neighbors were calculated. (auth)

46402 PHOTOELECTRIC PROPERTIES OF ANODIC OXIDE LAYERS ON TANTALUM. Hartl, M. (Technische Hochschule, Munich). Z. Angew. Phys., 23: 337-41(Oct. 1967). (In German).

The photoelectric properties of anodic oxide layers on tantalum were investigated with monochromatic uv-light and x-ray irradiation. The results can be explained uniformly by the production of carriers in the oxide. The photovoltaic properties of the layers result from different height of the potential barriers at the oxide interfaces; this difference of the barrier heights can be determined by these measurements. In the range of the investigated thickness it seems that with formation voltage applied nearly all of the induced carriers arrive at the electrodes. (auth)

46403 SCALING LAWS FOR ISING MODELS NEAR CRITICAL POINTS. Kadanoff, L. P. (Univ. of Illinois, Urbana). pp 24-36 of Proceedings of the 1966 Midwest Conference on Theoretical Physics, Indiana University, May 20–21, 1966. Lichtenberg, D. B. (ed.). Bloomington, Ind., Indiana University, 1966.

See CONF-660545.

The present state of knowledge of the behavior of systems very near a second-order phase transition is considered. The problem is illustrated by using as an example of a system which undergoes a phase transition, the Ising model. Emphasis is placed on the peculiar behavior which occurs in the region about the critical point at $T = T_c$ and $B = 0$. It is noted that the ideas discussed may be naturally extended to real systems undergoing second-order phase transitions. (J.F.P.)

46404 DIFFUSION IMAGES OF PROTONS FOR THE STUDY OF THE STRUCTURE OF MONOCRYSTALS. Nelson, Richard Stuart. Sci. Progr.-Nature, No. 3387, 266-8(July 1967). (In French).

The manner in which the regular arrangement of the atoms of a crystal can affect the distribution of protons scattered by the surface layers of solids is examined. It is shown how channeling can be used as the basis of a new technique for the study of crystalline structures. (J.S.R.)

46405 CHANGE IN ELECTRICAL RESISTIVITY IN THE α PHASE OF SCANDIUM HYDRIDE. Azarkh, Z. M.; Funin, V. N.; Yur'eva, N. D. Sov. Phys.-Solid State (Engl. Transl.), 9: 1066-7(Nov. 1967).

Translated from Fiz. Tverd. Tela, 9: 1364-6(May 1967).

The electrical resistivity of scandium hydrides with the hydrogen concentration ranging from 0 to 30 at. % (α phase) was measured. It is shown that within this concentration region the electrical resistivity of scandium hydride increases with increasing hydrogen content, which is analogous to the change in electrical resistivity in the palladium–hydrogen system. It is noted that there is an interdependence between the change in the electrical resistivity and the crystallographic lattice parameters for the scandium–hydrogen system, such as has previously been observed for palladium hydride. (auth)

46406 ELECTRICAL PROPERTIES OF SOLID SOLUTIONS OF CARBIDES OF THE TRANSITION METALS OF GROUP IV AND V. Golikova, O. A.; Dzhafarov, E. O.; Avgustinnik, A. I.; Kudryashova, L. V.; Ordan'yan, S. S. (Inst. of Semiconductors, Leningrad). Sov. Phys.-Solid State (Engl. Transl.), 9: 1228-9 (Nov. 1967).

Translated from Fiz. Tverd. Tela, 9: 1557-8(May 1967).

The electrical properties of ZrC–NbC and ZrC–TaC solid solutions were investigated as a function of the amount of group-V metal present. A plot of carrier density versus the Nb and Ta content at room temperature shows a continuous rise in carrier density as the number of group-V-metal atoms increases. It appears that, in general, the carrier density increases because atoms of a group-V metal give up their excess electrons to the common electron system. The resistivity and thermoelectric power are correlated with the carrier density variation in all these solid solutions. (A.G.W.)

46407 STUDY OF NUCLEAR γ RESONANCE AFTER α DECAY. Belozerskii, G. N.; Nemilov, Yu. A.; Chaikhorskii, A. A.; Shvedchikov, A. V. (Leningrad State Univ.). Sov. Phys.-Solid State (Engl. Transl.), 9: 978-9(Oct. 1967).

Translated from Fiz. Tverd. Tela, 9: 1252-4(Apr. 1967).

The nuclear gamma resonance spectrum of ^{237}Np formed by α decay of ^{241}Am was investigated experimentally. In experiments using Np_2O_5 as absorber and $AmCl_3$ as source, the Moessbauer effect was absent to within 0.2%. In experiments using NpO_2 as

absorber and AmO_2 as source, a Moessbauer line was observed. Interpretation of these results is considered. A search for the nuclear gamma resonance in ^{233}U and ^{239}Pu using various γ spectrometers to study the γ spectra of ^{233}Pa and ^{239}Np sources yielded negative results. (A.G.W.)

46408 RECOVERY OF ELECTRON-IRRADIATED ALUMINUM AND ALUMINUM ALLOYS. II. STAGE II. Garr, K. R. (Atomics International, Canoga Park, Calif.); Sosin, A. Phys. Rev., 162: 669-81(Oct. 15, 1967).

The recovery of the residual electrical resistivities of pure Al and the Al (nominally 0.1 at. %) alloys Al–Mg, Al–Ga, and Al–Ag has been investigated following 1-MeV electron irradiation near 4°K. The addition of solute atoms caused a suppression of recovery normally observed in stage I (<70°K) for pure Al. This suppression amounted to 20 to 27% of the recovery of the pure sample. The stage-II (70 to 170°K) recovery of pure Al occurs throughout the whole temperature range. However, well-defined recovery regions were observed between 70 and 90°K and between 120 and 140°K. In the alloy system, the recovery characteristics varied with the particular solute addition. Specifically, Al–Mg showed two distinct substages of recovery in stage II, centered at 81 and 127°K. Al–Ga showed a doublet (two partially overlapping substages) centered at about 111°K. Al–Ag showed no distinct substages of recovery that could be attributed to the addition of the solute. None of the substage kinetics follow integral reaction orders when analyzed with chemical rate theory, indicating complex annealing processes. (auth)

46409 RECOVERY OF ELECTRON-IRRADIATED ALUMINUM AND ALUMINUM ALLOYS. III. STAGE III. Garr, K. R. (Atomics International, Canoga Park, Calif.); Sosin, A. Contract AT(04-3)-701, Phys. Rev., 162: 681-9(Oct. 15, 1967).

The recovery of the residual electrical resistivities of pure Al and the Al alloys (nominally 0.1 at. %) Al–Mg, Al–Ga, and Al–Ag have been investigated following 1-MeV electron irradiation near 4°K. Analysis of the data for nominally pure Al in stage III (170 to 300°K) discloses substructure. A very small substage occurs at lower temperatures and appears to be influenced by the residual impurities. The main portion of the stage shows a variation in the observed activation energy with purity: The higher the purity of the as-received material, the lower the observed activation energy. A range of 0.46 to 0.59 eV was found for the materials investigated. The effective frequency factor for these materials showed a concurrent systematic variation. These effects are believed to be due to the interaction of migrating defects with residual impurities in the material. The recovery of the alloys in the stage-III region is more complex than in the pure material. There is more substructure in the recovery spectrum of the alloys, and the observed activation energies in stage III are higher. Al–Ag showed a resistivity decrease followed by an increase attributed to the clustering of Ag atoms. The observations are interpreted in terms of interstitial migration, restricted by impurities, in the earlier portion of stage III; vacancy migration becomes important in the latter portion of stage III. Stated differently, interstitials migrate in stage III and vacancies migrate in stage IV, but in Al these stages overlap appreciably. (auth)

46410 NUMERICAL CALCULATIONS OF THE YIELD AND FANO FACTOR ACCORDING TO VAN ROOSBROECK'S STATISTICAL MODEL FOR SEMICONDUCTORS. Di Cola, G.; Farese, L. (Joint Nuclear Research, Ispra, Italy). Phys. Rev., 162: 690-92(Oct. 15, 1967).

The yield and Fano factor of electron–hole pairs generated in semiconductors have been calculated by means of a numerical method based on van Roosbroeck's statistical model. The numerical approach allows easier further investigation on the model and gives results that fit previous Monte Carlo calculations better than analytical methods do. (auth)

46411 DE HAAS–VAN ALPHEN EFFECT AND FERMI SURFACE IN THORIUM. Thorsen, A. C.; Joseph, A. S.; Valby, L. E. (North American Aviation Science Center, Thousand Oaks, Calif.). Phys. Rev., 162: 574-7(Oct. 15, 1967).

de Haas–van Alphen effect studies have been carried out on the actinide metal thorium. Although sample purities were quite low, two groups of oscillations could be observed throughout the {110} and {100} symmetry planes. These data suggest that the Fermi surface consists of at least a closed segment situated at the point Γ in the center of the Brillouin zone and a set of six closed segments located along the ⟨100⟩ axes at the symmetry point X. (auth)

46412 X-RAY-INDUCED FIRST-STAGE COLORING OF NaCl. Alvarez Rivas, J. L. (Junta de Energia Nuclear, Madrid); Levy, P. W. Phys. Rev., 162: 816-23(Oct. 15, 1967).

The initial or first-stage F-center coloring of NaCl, irradiated with x rays at room temperature, has been carefully studied. Both Korth and Harshaw samples were used. The first-stage coloring is modified by changing the experimental conditions. These include altering the dose rate; subjecting the crystals to plastic deformation before irradiation; and cycles of coloring, bleaching, and recoloring. The observed curves of F-center concentration versus dose can be resolved into one linear and three additional components. Two of these can be considered saturating exponentials. The third, which does not occur in every curve, may also be a saturating exponential, but is too weak to characterize precisely. Changing the experimental conditions alters one or two of the exponential components but leaves the others unchanged. This suggests that each component is related to a separate process and that the resolution into components is not fortuitous. The linear component is unaffected by all the above-mentioned changes in experimental conditions. The exponential component that varies most slowly, as a function of irradiation time, is independent of dose rate and prior coloring and bleaching. Its saturation level is increased by plastic deformation prior to irradiation, but only after the strain has exceeded a threshold value. Beyond this threshold strain, the saturation level increases linearly with strain. The saturation level of the next slowest component is unaffected by strain. However, it is increased by a coloring–bleaching–recoloring cycle and is a function of dose rate. This dose rate dependence is given by the expression: $C_1 + C_2I^2$, where C_1 and C_2 are constants and I is proportional to x-ray intensity. The saturation level of the third and fastest-changing component is always less than 10% of the total exponential contribution and is too small to study in detail. In the 185- to 350-mμ region both the absorption spectrum and the behavior under the various experimental conditions differ considerably in the two types of crystals. Also, the coloring curves seem to be strongly dependent on impurity content in a way that is also different in the two types of crystals. (auth)

46413 ELECTRON IRRADIATION OF COAL. Brown, D. J.; Pitt, G. J. Fuel, 43: 445-51(Nov. 1964).

Irradiation of coal was conducted with monoenergetic (2 MeV) electrons produced by a van de Graaff generator. Sample temperatures were kept at or near 25°C so that partial carbonization by overheating of the samples could not occur. To determine the yield and composition of any gas evolved as a result of irradiation, the gas in the coal was first removed by prolonged pumping, at a temperature a little higher than that which the coal reached during irradiation. The coal was then irradiated under a vacuum. Specially picked samples of 3 vitrinites were irradiated to doses of 300 and 1200 Mrad. Small amounts of gas were evolved, up to 1.3 ml/g, of which the main components were hydrogen and carbon dioxide; the properties of the coal showed little change. The G_{H_2} values were 0.03 to 0.04, the differences between these values and those reported by other workers (0.005 to 0.06) being attributed to temperature or intensity of irradiation effects. The results are discussed in relation to coal structure. (BBB)

46414 IDENTIFICATION OF ETCH FIGURES ON TRACKS OF FISSION FRAGMENTS IN IONIC CRYSTALS. Berzina, I. G.; Berman, I. B. (All-Union Scientific Research Inst. of Nuclear Geophysics and Geochemistry, USSR). Dokl. Akad. Nauk SSSR, 174: 553-5(May 21, 1967). (In Russian).

Certain ideas and report results are advanced of experiments aimed at establishing distinguishing features by which it is possible to separate, by etching, radiation-damage tracks from dislocations. The investigations were made on NaCl, KCl, LiF, and $CaCO_3$. The tracks were produced by bombardment with fission fragments from a ^{244}Cm source. Two methods of investigating the etch figures were used. One was to compare the etch figures on two mirror cleavage surfaces, one of which was irradiated after the cleavage. The second was to etch the same surface twice, and irradiating of the surface between the two etchings. The differences between the tracks and the dislocations were manifest by the fact that etching flattened the tracks but left the dislocation edges sharp. The tracks had lower thermal stability than the dislocations. Other features distinguishing dislocations from tracks were that tracks could terminate an arbitrary point of the crystal and can have an arbitrary orientation to the surface of the crystal. The results can be useful for geochronology and for the determination of small concentrations of uranium in natural crystals. (ATD)

46415 RADIATION ANNEALING OF SEEGER'S DEPLETION ZONE. Agranovich, V. M.; Mikhlin, E. Ya. Sov. Phys.-Solid State (Eng. Transl.), 9: 851-3(Oct. 1967).

Translated from Fiz. Tverd. Tela, 9: 1089-92(Apr. 1967).

A process that permits an explanation of the observed saturation of the critical shear stress as a function of the integrated fast neutron flux is treated. This process consists of a peculiar annealing of the Seeger depletion zone, connected with the damping of dynamic crowdions. (auth)

46416 COMPARISON OF SPECTRA OF COLD NEUTRONS SCATTERED BY AMORPHOUS AND CRYSTALLINE SELENIUM. Kotov, B. A.; Okuneva, N. M.; Regel', A. R.; Shakh-Budagov, A. L. (Inst. of Semiconductors, Leningrad). Sov. Phys.-Solid State (Engl. Transl.), 9: 955-7(Oct. 1967).

Translated from Fiz. Tverd. Tela, 9: 1227-30(Apr. 1967).

The influence of long- and short-range order on the form of the vibrational spectrum was investigated using inelastic scattering of slow neutrons. (auth)

46417 FORMATION OF CONDUCTIVITY ELECTRON BOUND STATES WITH LOCALIZED SPINS IN METALS. Abrikosov, A. A. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz., 53: 1078-88(Sept. 1967). (In Russian).

A theory is developed which can be employed for studying the electron bound states with localized spins of arbitrary magnitude. It is shown that states with a total spin $S + \frac{1}{2}$ are not realized. The problem for states with $S - \frac{1}{2}$ cannot be solved finally within the framework of the logarithmic approximation since the amplitude of the state is proportional to an unknown constant which may even be zero. It is shown that if the amplitude is not zero the formation of bound states lowers the energy of the system. (auth)

46418 COMPTON SCATTERING FACTORS FOR SPHERICALLY SYMMETRIC FREE ATOMS. Cromer, Don T.; Mann, Joseph B. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. J. Chem. Phys., 47: 1892-3(Sept. 15, 1967). (LA-DC-8819).

Incoherent scattering factors for all spherically symmetric free atoms have been computed from numerical SCF Hartree–Fock wave functions. The complete Waller–Hartree theory with all exchange terms has been used. (auth)

46419 MAGNETIC SUSCEPTIBILITY OF SOME U^{4+} COMPOUNDS AT LOW TEMPERATURES. Dutta Roy, S. K.; Ghosh, B.; Sahoo, B. (Indian Inst. of Tech., Kharagpur). Indian J. Phys., 41: 362-72(May 1967).

Magnetic susceptibility of three U^{4+} compounds were examined over a temperature range of 400 to 100°K. Appreciable variation of magnetic moment for U^{4+} ion from salt to salt and also with temperature was observed for all the compounds. A theory of magnetic susceptibility based on point charge model was worked out for U^{4+} ion in crystalline state. The calculation yields a nonmagnetic singlet as the ground state and a doublet close to it. The experimental results are satisfactorily explained. (auth)

46420 INTERACTION BETWEEN LOCALIZED MOMENTS IN METALS. Inoue, Michiko; Moriya, Toru (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 38: 41-60(July 1967).

Interaction energy between two localized moments is calculated on the tight-binding or Wolff–Clogston model by using the Hartree–Fock approximation. A simple general expression is obtained for the effective exchange energy between a distant pair of moments which generally decays as R^{-3} with the oscillations given by the stationary radii of the Fermi surface. Interaction between an adjacent pair of moments is shown to be of local character and its sign is primarily governed by the electronic occupation in the impurity states. A general rule for the sign of the coupling between two moments proposed earlier on the basis of the Anderson model is strongly supported. Possible discontinuous occurrence of localized moments in some alloys is also discussed on the same model. (auth)

46421 A POSSIBLE MODEL FOR V CENTERS STABLE AT ROOM TEMPERATURE IN X-IRRADIATED KCl(Ca) CRYSTALS. Voszka, R.; Horvath, T.; Watterich, A. (Research Lab. on Crystal Physics, Budapest). Phys. Status Solidi, 23: K71-3 (Sept. 1, 1967).

The absorption spectrum produced by room-temperature x irradiation of OH-free KCl:Ca quenched to 93°K is shown. Two V-type bands are attributed to V_2 centers and to V_K centers, respectively. Disappearance of the V_K band in an hour is accompanied by a slight increase of absorption in the V_2 band. It is suggested that the V_2 center is created by the association of two V_K centers. A model is proposed according to which the V_2 center consists of a Cl_i^- ion situated in the place of one negative and two positive vacancies next to two Ca^{++} ions. The model is consistent with results of other investigators. (A.G.W.)

46422 X-RAY DIFFUSE SCATTERING IN γ-IRRADIATED LiF. Peisl, H.; Spalt, H.; Waidelich, W. (Technische Hochschule, Darmstadt, Ger.). Phys. Status Solidi, 23: K75-8(Sept. 1, 1967).

Single crystals of LiF were γ-irradiated in a ^{60}Co source at room temperature, and the x-ray diffuse scattering by the irradiated crystals was investigated. The scattering intensity as a function of distance from the reciprocal lattice point 400 for different irradiation times and the scattering intensity and color center concentration as functions of irradiation time are shown. The following conclusions are drawn: (1) x-ray diffuse scattering according to the lattice distortion by defects can be described by an equation based on elastic theory; (2) different defects are created by short and prolonged irradiation; and (3) x-ray diffuse scattering intensity is a very sensitive measure for the lattice distortion by defects. (A.G.W.)

46423 MEASUREMENT OF THE COMPTON BAND ON BERYLLIUM SINGLE CRYSTALS. Schuelke, W.; Berg, U. (Martin-Luther-Univ., Halle, Ger.). Phys. Status Solidi, 23: K87-91 (Sept. 1, 1967).

Compton scattering experiments were performed on Be single crystals using two orientations of the crystal: k ||[001] and k ||[100]. The primary x-ray wavelength and the scattering angle were so chosen that one branch of the Compton profile originated only from valence electrons. The resulting Compton profiles for the two orientations are shown. There are some intrinsic differences between the two orientations with respect to the valence electron parabola. The maximum of the Compton line was obtained at a value of $h\omega$ smaller by 2.9 eV than that predicted by the theory for free electrons. The separated Compton profile of bound electrons begins at $h\omega = 113$ eV, which agrees with the ionization energy of K electrons of Be. Values of the maximum occupied momentum of valence electrons for each orientation were found. (A.G.W.)

46424 THE INFLUENCE OF ELECTRON-TRAPPING IMPURITY ON DEFECT CREATION AND BLEACHING IN KCl IRRADIATED AT 78°K. Crawford, J. H. Jr.; Sibley, W. A.; Sonder, E. (Oak Ridge National Lab., Tenn.). Phys. Status Solidi, 23: 301-6(Sept. 1, 1967).

The excitonic mechanism for creation of halogen Frenkel-type defects in alkali halides predicts an early positive curvature in the defect growth curve. The model also predicts that annihilation of V_K centers by the optical release of electrons from traps would produce Frenkel pairs in the halide sublattice. The first prediction has been checked in KCl:Tl^+ and KCl:Pb^{++} irradiated at 78°K with 1.7-MeV Van de Graaff electrons, and the second upon ir bleaching of an irradiated Tl^+-doped crystal at 78°K. If one takes the F-center concentration as a measure of the Frenkel-defect density, both tests were positive. A careful monitoring of the α-band region before and after bleaching, however, indicates that the F-center concentration is not a valid measure of the vacancy density. In a crystal containing 48 ppM Tl^+, the α-center concentration after irradiation at 80°K was 2.5 times that for F centers. Moreover, ir bleaching of Tl^+ and V_K, while enhancing the F band ≈30%, destroyed nearly all of the α centers. The last observation reveals that more empty halide vacancies are destroyed than F centers are produced by the bleaching light. (auth)

46425 ON THE ISOTOPE EFFECT IN INTERSTITIAL DIFFUSION. III. QUANTUM CORRECTIONS. Pegel, B.; Lepski, D. (Institut fuer Metallphysik und Reinstmetalle, Dresden). Phys. Status Solidi, 23: 335-9(Sept. 1, 1967).

A one-dimensional Prigogine–Bak model of interstitial diffusion, which has been discussed classically in two earlier papers, is treated quantum mechanically. By means of S-matrix theory an energy transport equation is established for the diffusing particle. By solving this equation with the appropriate Prigogine–Bak boundary condition, the quantum corrections for the frequency factor of the diffusion constant are obtained. It is found that the classical isotope effect is generally reduced by these corrections, which are important for small interstitial masses and/or low temperatures. (auth)

46426 POINT DEFECTS IN NEUTRON-DAMAGED SILICA GLASS. Lungu, S. (Inst. for Atomic Physics, Bucharest). Phys. Status Solidi, 23: 147-56(Sept. 1, 1967).

A point-defect structure for neutron-damaged silica glass is postulated. Pease's formula as tested by Monte Carlo calculations using a special closed model of a silica glass lattice is applied to the experimental volume compaction data, by considering SiO_2 point defects. Some new experimental data, which are presented here, are used to compute the threshold energies. (auth)

46427 MOESSBAUER SPECTRA IN THE PRESENCE OF ELECTRON SPIN RELAXATION. I. Gabriel, H. (Technische Hochshule, Brunswick). Phys. Status Solidi, 23: 195-205(Sept. 1, 1967).

The effect of time-fluctuating electronic spins (magnetic fields) on the hyperfine splitting of the Mössbauer spectra is investigated. The author's previous formal theory, which utilizes the Liouville formalism due to Zwanzig, is briefly outlined and extended by considering relaxation effects in more detail. The solution for large times involves a superposition of frequency-shifted Lorentzian lines with modified line widths. The frequency shift and the change

in line width are obtained as functions of the nuclear spins, the magnetic quantum numbers, the magnetic moments, and of correlation functions defined in terms of the fluctuating spins. (auth)

46428 INFLUENCE OF OXYGEN SEGREGATIONS IN SILICON SINGLE CRYSTALS ON THE HALFWIDTH OF THE DOUBLE-CRYSTAL ROCKING CURVE OF THERMAL NEUTRONS. Eichhorn, F.; Sippel, D.; Kleinstueck, K. (Technische Univ., Dresden. Zentralinstituts fuer Kernforschung, Rossendorf, Ger.). Phys. Status Solidi, 23: 237-40(Sept. 1, 1967).

Oxygen segregations in silicon crystals produced by the Czochralski method are shown to be arranged on "Wendelflächen" by the Schwuttke model. The crystal lattice therefore contains an anisotropic distortion field. A study is made of the effect of this distortion on the half width of double-crystal rocking curves for thermal neutrons. (auth)

46429 A DETERMINATION OF THE FERMI SURFACE OF BERYLLIUM BY THE DE HAAS–VAN ALPHEN TECHNIQUE. Genberg, Richard William. Cleveland, Case Inst. of Tech., 1965. 80p.

Thesis.

In a study of the diamagnetic susceptibility in beryllium using automatic recording of the torque as a function of the reciprocal of the magnetic field at low temperature and low field, six sets of frequencies have been observed. Three sets of frequencies have been attributed to portions of the Fermi surface and show good agreement with the model proposed by B. R. Watts. This model exhibits considerable deviation from the free-electron model. Cyclotron masses have been measured for these three sets of frequencies. Two other sets of frequencies and at least part of the remaining set have been attributed to the nonlinear effects of magnetic interaction. (Disser. Abstr.)

46430 PRESSURE DEPENDENCE OF THE ENERGY OF THE RESONANCE GAMMA RAY OF ^{197}Au AND THE HYPERFINE STRUCTURE COUPLING OF ^{197}Au IN THE ORDERED GOLD–MANGANESE ALLOYS. Patterson, David Owen. Knoxville, Tenn., Univ. of Tennessee, 1966. 115p.

Thesis.

The pressure dependence of the Mössbauer isomer shift of ^{197}Au has been measured at 4.2°K to a pressure of 70.6 kilobars. The shift with respect to metallic gold at zero pressure was fit by the parabola $v_I = 3.78 \times 10^{-3} P - 5.6 \times 10^{-6} P^2$ where v_I is in mm/sec and P is in kilobars. This result is in excellent agreement with that predicted by Roberts et al. The result confirms that in all the gold alloys thus far studied the electronic charge density near the gold nucleus is greater than it is in metallic gold. The hyperfine structure coupling of ^{197}Au in ordered $AuMn_3$, AuMn, Au_2Mn, Au_3Mn, Au_4Mn and solutions containing 0.3 and 1 at. % gold in manganese was measured. The results reflect the crystalline and magnetic structure for the different systems. Values are given for the magnetic field, electric field gradient, and isomer shift for ^{197}Au in the alloys. From the ground state splitting in Au_2Mn, the value of the magnetic moment of the 77.345-keV excited state of ^{197}Au was determined to be $\mu^* = 0.420 \pm 0.004$ nuclear magnetons. The hyperfine structure coupling of ^{197}Au in Au_2Mn was also studied at 15.4 and 31.1 kilobars. The isomer shift and magnetic field at the gold nucleus increased with pressure. (Disser. Abstr.)

46431 STUDIES OF CENTERS PRODUCED IN SAPPHIRE AND RUBY BY GAMMA RADIATION. Philbrick, Charles Russell. Raleigh, N. C., North Carolina State Univ., 1967. 107p.

Thesis.

The centers produced by gamma radiation in sapphire and ruby crystals have been studied using several experimental techniques. The optical absorption of gamma-radiation-induced center bands has been studied using plane polarized light to investigate the optical properties along axes perpendicular and parallel to the C axis. This technique allows determination of the anisotropy of the radiation-produced centers. Optical absorption bands were produced by gamma irradiation in the sapphire samples at approximately 6.0, 5.5, 4.2, and 3.0 eV for absorption measurements with the plane of polarization parallel to the C axis. For absorption measurements with the plane of polarization perpendicular to the C axis, the gamma-radiation-produced bands were found at approximately 6.0, 5.6, 4.55, and 3.1 eV. The optical absorption spectra were resolved into Gaussian curves using a computer reduction. The 6-eV absorption band, which has not previously been reported in gamma-irradiated sapphire, is associated with an electron bound at an interstitial aluminum ion. The band at 3 eV together with its anisotropy were found to correspond well with the prediction of Bartram et al. (1965) based on ESR studies of a center which was attributed to an O^- adjacent to a charge-deficient cation site. The optical absorption studies of the irradiated ruby samples showed that prominent center bands occur at 2.64, 4.30, 5.85 and 6.1 eV. The center bands at 2.64 and 4.3 eV possess negative anisotropy and the 5.84 eV band exhibits positive anisotropy. In addition, the results of studies of glow curve measurements, thermoluminescent emission, electrical conduction and step annealing experiments are reported and discussed for the centers produced in ruby and sapphire crystals by gamma radiation. Also, the thermal activation energies of the sapphire centers have been calculated by three different methods and were found to be in agreement. (Disser. Abstr.)

Theoretical Physics

Refer also to abstracts 46057, 46153, 46499, and 46525.

46432 (N–67-19245) EFFECTS OF THE NODAL REGRESSION OF THE ORBIT ON THE GRAVITY PRECESSION OF A GYROSCOPIC SATELLITE. Myers, James L. Jr. (Illinois Univ., Urbana. Coordinated Science Lab.). July 1966. Contract DA-28-043-AMC-00073(E). 23p. (NASA-CR-82592; R-309). CFSTI.

A gyroscopic satellite has been proposed for a test of the general theory of relativity in which the gyro "drift" rate to be measured is less than seven seconds of arc per year. The Coordinated Science Laboratory has proposed a simple passive gyroscope which uses sunlight reflected from mirrors to provide optical data to determine the spin axis orientation. The gravity gradient torque acting on the satellite is one of several extraneous disturbances which can cause spurious precession of the gyro spin axis. In this paper, general equations for the precession of a gyro satellite in a regressing orbit are derived. These equations may be used to specify the tolerances for initial spin axis and orbit alignments which enable an accurate measurement of the relativity effect. (auth)

46433 (AD–642797) GENERAL RELATIVITY AND QUANTUM THEORY. Final Scientific Report, February 1, 1965–August 31, 1966. Laurent, B. (Stockholm Univ. (Sweden). Inst. of Theoretical Physics). Contract AF61(052)-865. 5p. (AFOSR–66-2699). CFSTI.

A new method to produce gravitational radiation by stimulated emission, using photons as the stimulating particles, is suggested. Such a process should occur in some stars, and it has important possibilities in connection with gravitational lasers. Calculations show that soft gravitational radiation could interact with light more than has hitherto been assumed. The mixed Compton effect and the behavior of superconductors in gravitational fields were also studied as well as a generalization of the 5-dimensional theory to account for PC nonconservation. (auth) (TAB)

46434 (N–67-23082) FIFTY YEARS OF QUANTUM THEORY. Heisenberg, W. Translated by Barbara Crossland (Royal Aircraft Establishment, Farnborough, Eng.), from Naturwissenschaften, 38: 49-55(1951). 15p. (RAE-Lib-Trans-1202). CFSTI.

Quantum theory up to 1950 is reviewed. All the important theories and discoveries are described in a qualitative, sometimes metaphysical, manner. Some insight into the conceptual difficulties encountered by physicists fifty years ago is provided by a description of the author's own work in the field of quantum theory. Every development of the theory is mentioned, though sometimes only briefly. The article provides a starting point for detailed reading of any aspect of quantum theory. (auth)

46435 HOENL–DEHNEN FORMULATION OF MACHIAN PRINCIPLES. Ehlers, J.; Schuecking, E. (Univ. of Texas, Austin). Z. Phys., 206: 483-91(1967). (In German).

It is shown that the classification of curved space–times into Machian and anti-Machian world models proposed by Hönl and Dehnen is inadequate. It is proved that even the static Einstein model would be anti-Machian according to the definition of these authors, in contrast to their assertion. The proof is based on the theorem that any Robertson–Walker space–time admits regular source-free Maxwell fields. (auth)

46436 REPLY TO THE WORK OF J. EHLERS AND E. SCHUECKING ON THE FORMULATION OF MACHIAN PRINCIPLES. Hoenl, H.; Dehnen, H. (Univ., Freiburg i. B.). Z. Phys., 206: 492-502(1967). (In German).

After a short explanation of the viewpoint for general relativistic dynamics the objections of Ehlers and Schuecking against the author's formulation of Machian principles is taken up. (tr-auth)

46437 EQUALITY OF AN EXTERIOR PRODUCT AT UNIVERSAL VECTORS OF A TENSOR ELECTROMAGNETIC FIELD CREATED BY EXACT CHARGE. Boudet, Roger. Compt. Rend., Ser. A and B, 264: 1174-6(June 26, 1967). (In French).

Previous work on the equality of an exterior product of universal vectors of a field produced by $M = x^\mu e_\mu$ ($\mu = 1, 2, 3, 4$, x^μ are Minkowski coordinates of the point M) by an exact charge is considered again in more detail. (J.F.P.)

46438 ALTERNATIVE TO THE ORTHODOX INTERPRETATION OF QUANTUM THEORY. Pearle, Philip (Harvard Univ., Cambridge, Mass.). Amer. J. Phys., 35: 742-53(Aug. 1967).

An alternative calculational procedure for quantum theory is presented, employing three features which differ from the corresponding features of orthodox quantum theory. These are: (1) the state vector is never to be "reduced"; (2) quantum theory only makes predictions about ensembles of identical experiments (not about individual experiments); and (3) the measuring apparatus must always be included in the state vector. What is new about this alternative theory is the demonstration that (2) and (3) (which have hitherto been discussed separately) can be consistently combined to yield an interpretation of quantum theory which has the additional advantage of (1). It is shown that alternative and orthodox theories yield identical predictions for any practical experiment. However, two classes of experiments (which are impractical) for which the orthodox and alternative theories yield different predictions are described. Therefore, it is, in principle, possible to decide which theory nature has chosen to obey. It is concluded that there is no reason, based upon experimental evidence, for preferring one theory over the other. (auth)

46439 "CANONICAL" REPRESENTATIONS OF THE INHOMOGENEOUS LORENTZ GROUP. Lugarini, G.; Pauri, M. (Istituto Nazionale di Fisica Nucleare, Parma, Italy). Ann. Phys. (N.Y.), 44: 266-88(Sept. 1967).

A systematic characterization is given of the basic unitary representations of the inhomogeneous Lorentz group which are of interest in classical mechanics. The study is carried out on the ground of a representation theory for classical mechanics previously proposed. Accordingly, the irreducible representations, in the "classical" Hilbert space of Koopman–von Neumann, which are the proper unitary counterpart of the canonical (phase-space) realizations of the Poincaré group in the neighborhood of the identity ("canonical" representations) are classified and explicitly derived. The irreducible "canonical" representations which can be taken into account from a physical point of view are essentially of three kinds: representations corresponding to free particles of finite rest mass and arbitrarily fixed spin; representations corresponding to particles of zero rest mass pure, arbitrarily fixed, helicity and, finally, other representations describing systems of zero rest mass with a "spin" which depends on the Lorentz frame and can assume any positive real value. Except possibly for the photon, the last two classes can hardly be connected with realistic classical models. The related relativistic Liouville equations of motion are deduced. (auth)

46440 COSMOLOGICAL CONSTANT AND PERIHELION PRECESSION. Alpher, Ralph A. (General Electric Research and Development Center, Schenectady, N. Y.). Amer. J. Phys., 35: 771(Aug. 1967).

The precise and trivial effect of a nonzero cosmological constant on the perihelion of Mercury is shown. (W.D.M.)

46441 RAINICH GEOMETRIZATION OF FERMION FIELDS. Kuchar, K. (Charles Univ., Prague). Wiss. Z. Friedrich-Schiller-Univ., Jena, Math.-Naturwiss. Reihe, 15: 95-9(1966).

The Rainich unification of coupled electromagnetic and gravitational fields introduced a procedure by which an arbitrary wave field can be given a geometrical interpretation within Einstein's original theory. The Rainich problem for the simplest boson fields (neutral and charged scalar fields) has been solved, and the difficulties connected with Rainich geometrization of fermion fields discussed for the neutrino field. A formal geometrization of the neutrino field has been attempted. By the analysis of the procedure used in this attempt, the present author ascertained that the final failure of a complete Rainich geometrization of the neutrino field is caused by the lack of direct geometrical interpretation of spin density tensor, which for the neutrino is determined by a four-current. It is known that during the transcription of spinor equations into curved spaces the Riemannian structure of the space must be enriched by a tetrad field or a field of axiomatically introduced spinor matrices $g_{\mu}AB$. Some recent reports have taken for granted that the spin of a source field has an influence on the new geometrical characteristics. As an example, Kibble's version is examined, in which the spin is connected with the antisymmetric part of affine connection and thereby geometrized. It is shown that the geometrization of the spin offers a natural basis for a full Rainich geometrization of not only the neutrino, but even of the Dirac bispinor field. The results demonstrated that the geometrization of spin within the framework of Kibble's theory enables the complete Rainich geometrization of fundamental fermion fields. (BBB)

46442 SURVEY OF INVESTIGATIONS ON THE ENERGY-MOMENTUM COMPLEX IN GENERAL RELATIVITY. Moeller, C. (Univ. of Copenhagen). Kgl. Dan. Vidensk. Selsk. Mat.-Fys. Medd., 35: No. 3, 14p(1966).

Starting with the well-known expression for the energy–momentum complex $({}_{E}T_{i}^{k} = T_{i}^{k} + {}_{E}T_{i}^{k})$ as formulated by Einstein in his approach to the problem of energy and momentum conservation for the complete system of matter plus gravitational field, various subsequent approaches to this problem are outlined. For a closed system and for a restricted class of coordinate systems, the quantities obtained from ${}_{E}T_{i}^{k}$ by integrating over spatial coordinates are examined. By integrating over a suitable cylindrical region of space–time and using Gauss's theorem it can be shown that these quantities $({}_{E}P_{i})$ have the following properties A, which are essential for the interpretation of P_i as the components of the 4-momentum: (A) For a closed system and in a system of BS coordinates the quantities P_i are constant in time and they transform as the components of a 4-vector under all linear transformations; and (B) For a closed physical system the total 4-momentum is a free 4-vector under arbitrary space–time transformations. A discussion is given of which properties of the energy–momentum complex T_{i}^{k} are necessary and sufficient in order that the integrated quantities P_i have all the properties A and B. In any system of BS coordinates, the values of P_i obtained from the tetrad complex are the same as those obtained from the metric complexes of Einstein. Therefore, once the generally covariant expression of P_i has been established by way of the tetrad formalism, the tetrads may be neglected and the calculation made of P_i in a system of coordinates in which the purely metric-dependent complexes are known to be valid. Then, the values of P_i in an arbitrary system of coordinates can be obtained by using the law of transformation of a 4-vector. (BBB)

46443 A RELATIVISTIC VIRIAL THEOREM FOR A SYSTEM OF CHARGED PARTICLES MOVING IN AN EXTERNAL ELECTROMAGNETIC FIELD. Rubin, N. B. Zh. Tekh. Fiz., 37: 1001-5(June 1967). (In Russian).

A relativistic virial theorem is described for a system of charged particles moving in a finite region of space in an external electromagnetic field, expressing the average energy of the particles and the field that they produce as the sum of the averages of two integrals, one of which is taken over the trace of the energy–momentum tensor of the particles alone, and the other involves the currents and the external field. In deriving the theorem, radiation losses were excluded by assuming the system to be enclosed by reflecting walls. The energy associated with the polarization of the material composing the source of the external field (which must be included within the enclosure) was not taken into account, and the theorem is therefore valid only when this energy is small or when radiation can be neglected. The theorem may be of use in the investigation of the behavior of storage rings, accelerators, plasma confinement systems, and other devices. (ATD)

46444 MOTION EQUATIONS OF A MACROSCOPIC ROTATING PARTICLE ACCORDING TO GENERAL RELATIVITY THEORY. Micoulaut, R. (Univ., Freiburg i. B.). Z. Phys., 206: 394-403(1967). (In German).

It is shown that under special covariant constraints the Papapetrou equations of motion of a spinning particle (rotating planet) moving in a spherically symmetric field (Schwarzschild field) give additional terms in the expressions for the advance of perihelion and the deflection angle of particle. (auth)

46445 UNIFIED FIELD THEORY BASED ON A SEMI-SYMMETRIC CONNECTION. George, T. L. (Univ. of Sierra Leone, Freetown). Nuovo Cim. (10), 51A: 664-73(Oct. 1, 1967).

A unified theory of electromagnetism and gravitation is proposed, which seems to be free from some of the difficulties of the other theories. The field equations are simpler and have exact solutions. The static electric field is finite everywhere including the origin; and although the gravitational field is not, yet they both tend to their classical values at large distances from the origin. It is also shown that the "λ transformations" of Einstein are no more than the gauge transformations of the electromagnetic potentials. (auth)

46446 GRAVITATIONAL BOUNCE. de la Cruz, V.; Israel, W. (Univ. of Alberta, Edmonton. Dublin Inst. for Advanced Studies). Nuovo Cim. (10), 51A: 749-50(Oct. 1, 1967).

A solution of Einstein's field equations is derived which represents a thin spherical shell of charged dust falling in the spherically symmetric field of a charged massive body placed at its center. Under suitable conditions the shell bounces reversibly at a nonzero minimal radius. A bounce is still possible even after the shell has collapsed inside the Schwarzschild sphere, so that the collapse as viewed externally is irreversible. The apparent paradox is explained in terms of the lattice-like structure of the analytically extended Reissner–Nordström manifold. The

possible relevance of the results to the problem of realistic gravitational collapse is discussed. (auth)

46447 METHOD OF SMALL PARAMETER FOR RELATIVISTIC ELECTRON IN QUANTUM MECHANICS. Shalbaev, E. B. pp 126-32 of Differentsial'nye Uravneniya i Ikh Primenenie. Amandosov, A. A. (ed.). Alma-Ata, USSR, Izdatel'stvo Nauka Kazakhskoi SSR, 1967. (In Russian).

Previously, Arzhanykh constructed a mathematical algorithm by means of which (using classical mechanics) it was possible to obtain equations for quantum mechanics. The algorithm is universal and offers equations for classical mechanics and for quantum mechanics. An attempt is made to apply the algorithm to the relativistic electron in quantum mechanics. (R.V.J.)

46448 PROBLEMS OF INTERPRETATION OF STATIONARY, RIGID, OR CONFORMABLY RIGID ds^2. Bel, Luis; Escard, Jean C. Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur., 41: 476-86(Dec. 1966). (In French).

The interpretation of a given ds^2 solution of the Einstein equations of space poses the problem of defining the concepts of the gravitational field, space, and time. This can be done by introducing a field of vectors oriented in time. Three cases are considered which correspond respectively to the cases in which this field of vectors is generated by a group of isometry, by a group of rigid motions, and by a group of so-called conformably rigid movements. In these three cases a projection formula is obtained which translates the field equations and the motion equations of test particles in the form of tensor equations to a Riemannian variety with three dimensions. In the first two cases the results are for the most part known and in the present article only some complementary observations are given. In the third case the results indicated are new. In general in all three cases it was possible to show the formal analogy which exists between the projection equations obtained and the Maxwell equations of electromagnetism written in three-dimensional formalism. (tr-auth)

46449 MANY-PARTICLE SYSTEMS. V. ZERO-RANGE INTERACTIONS. Hall, R. L. (London Univ.). Proc. Phys. Soc. (London), 91: 787-93(Aug. 1967).

Close upper and lower bounds are found on the binding energy of a system of N identical bosons interacting in one dimension by an attractive square-well pair potential. In the limit in which the potential has the shape of a δ function the bounds are found to be consistent with McGuire's [J. Math. Phys., 5: 622-36(1964)] exact solution. In three dimensions the limit of vanishingly small range, in which the two-particle binding energy is kept constant, gives infinite binding to the N-particle system, in agreement with Thomas's theorem. Consideration of other limiting process eliminates an apparent contradiction between Thomas and Svartholm. (auth) (UK)

46450 REMARK ON THE INITIAL VALUE PROBLEM OF THE EINSTEIN–MAXWELL FIELD. Langer, J. (Charles Univ., Prague). Czech. J. Phys., 17: 653-6(1967).

The initial value problem for the coupled gravitational and non-null electromagnetic fields is considered with the result that $g_{\mu\nu}$ and $g_{\mu\nu 0}$, specified almost freely on an initial space-like hypersurface, can always be interpreted as the geometrical initial data for the case considered. (auth)

46451 THE LORENTZ GROUP: AXIOMATICS–GENERALIZATIONS–ALTERNATIVES. Strauss, M. (Deutsche Akademie der Wissenschaften, Berlin). Wiss. Z. Friedrich-Schiller Univ., Jean, Math.-Naturwiss. Reihe, 15: 109-18(1966).

The two principles used by Einstein to establish the Lorentz group and the necessity of using them for this purpose are examined. It is pointed out that no equivalent substitute for the special theory of relativity exists, only nonequivalent alternatives. The second principle is correct but not required for the axiomatic foundation of the theory. Of the first principle only the weak implication is essential for kinematics; it amounts to little more than a definition of the uniform motion equivalence. The empirical content of the theory lies mainly in the possibility that it excludes: unlimited speed and the wrong sign of c^2, the double world implied by Gordon and Placios. The interrelation of speed and simultaneousness in their summation is irrelevant to the theory; it is based on an arbitrary and incomplete operational definition of velocity and does not appear in the final theory. If constant velocity is taken as a primary concept characterized by a set of postulates, the Lorentz group emerges as the mathematical expression of the uniform motion equivalence. There is one genuine generalization of the special theory, the general theory; this theory is more general because it includes gravitation. (BBB)

46452 DERIVATIVE METHOD IN MANY-BODY THEORY. Marburger III, John Harmen. Stanford, Calif., Stanford Univ., 1967. 142p.

Thesis.

The normal ordering techniques of Louisell, Walker and Heffner, previously restricted to systems described by hamiltonians at most quadratic in boson creation and annihilation operators, are here extended to the case of anticommuting operators and self-interacting systems. These techniques are closely related to the method of functional derivatives in quantum field theory, and the term "derivative method" is used here to emphasize this connection. This method is used to compute approximate expressions in normal form for the second quantized time evolution and density operators for systems of interacting particles. Extension of the method to anticommuting variables is accomplished by specializing the "anticommuting c-number" formalism of the functional derivative method and treating the derivatives so obtained in the same way as those appearing in boson normal ordering prescriptions. The need for modifications of the method for nonquadratic hamiltonians is shown by using the properties of derivative operators to prove that in this case closed solutions in normal form for the time evolution and density operators do not exist. In this case, the method presented here leads to an infinite coupled set of differential equations for certain coefficients appearing in the solutions. A physical interpretation for these coefficients is found by comparing the exponential trial function involved in the derivative method with the result of a "connected diagram theorem" which is presented here in a form somewhat more general than usual. This comparison shows in the case of the time evolution operator that the coefficients in question are equal to sums of connected diagram contributions. A similar formalism for the fourier transform of the density operator (characteristic function) leads to a system of equations for cumulant averages of products of the creation and annihilation operators. In both cases the infinite system may be truncated by ignoring higher order connected or cumulant terms. This procedure is similar to one employed in the theory of Green's functions whose relation to the method presented here is described briefly. Several problems are discussed in the context of the derivative method to illustrate the formalism. (Disser. Abstr.)

46453 LES THEORIES UNITAIRES DE L'ELECTROMAGNETISME ET DE LA GRAVITATION. (Unitary Theories of Electromagnetism and Gravitation). Tonnelat, Marie-Antoinette. Traite de Physique Theorique et de Physique Mathematique. XI. Paris, Gauthier-Villars, 1965. 545p.

The principles of the Maxwell electromagnetic theory and of general relativity theory are summarized. The classical unitary theories are then analyzed. The theories based on the use of Riemannian spaces with more than four dimensions are first considered. Classical unitary theories based on the use of non-Riemannian spaces with four dimensions are then discussed. General relativity in its relation with the electromagnetic theory and the quantum formalism is considered in the last section. The book is designed for students and new researchers. (J.S.R.)

46454 STATISTICAL THEORY OF CHARGED PARTICLE TRANSPORT IN DISORDERED MAGNETIC FIELDS. Roelof, Edmond Charles. Berkeley, Calif., Univ. of California, 1966. 225p.

Thesis.

The motion of a charged particle in a time-independent, spatially disordered magnetic field where particle and field parameters are such that the particle undergoes a "magnetic Brownian motion" is studied. This motion, where the variations in displacement are due to the cumulative effects of small Markovian random velocity fluctuations, leads to a true spatial diffusion process which becomes anisotropic when the mean part of the magnetic field significantly exceeds the root-mean-square random part. The critical parameter is the "relaxation time" (T) in which the velocity distribution, derived from the solution to a Fokker–Planck equation, relaxes to an asymptotic form independent of the initial distribution. The relaxation time is inversely proportional to the spatial power spectrum evaluated at the wavenumber equal to the inverse of the particle's relativistic gyro-radius in the mean field. The diffusion coefficient along the mean field is $\approx v^2T/6$ (where v is the particle velocity) and in the anisotropic case the ratio of the parallel to the transverse diffusion coefficient goes like the square of the number of gyrations (in radians) the particle makes in the mean field during one relaxation time (T). In the special case where the mean magnetic field is significantly greater than the root-mean-square random part of the field, the statistical parameters may be allowed to be weak functions of position, i.e., if the spatial dependence of the parameters can be characterized by the scale length (L) of the mean field and $vT < L$. The velocity anisotropy parameter $k \approx vT/2L$ then determines the asymptotic velocity distribution which peaks along the field line in the direction of decreasing field strength. The theoretical velocity distribution is compared with the proton flux anisotropies measured by Pioneer VI for the event of December 30, 1965. An appropriate one-dimensional diffusion equation is derived in curvi-

linear coordinates and it is shown that agreement with observed time histories of solar proton events implies a position-dependent diffusion coefficient which is a functional of the mean magnetic field. With Parker's spiral quiet-day field as a model for the mean field, the spatial variation of the diffusion coefficient and other propagation parameters is inferred for radial distances between 0.1 and 10 AU. The spatial power spectrum of the magnetic field at 1 AU is derived from the diffusion coefficients obtained from proton observations over the past decade and is compared with the power spectrum obtained from the magnetic-field measurements of Mariner 2. By using the energy and spatial dependence of the diffusion coefficients for the solar proton event of September 28, 1961, the power spectrum deduced from that event is transformed into the spectrum at positions elsewhere in the solar system. The diffusion-like solar electron events of 1965 are discussed, but agreement with theory is less satisfactory than for solar proton events. Some suggestions are offered to explain the discrepancy. (Disser. Abstr.)

46455 QUANTUM MODEL OF IRREVERSIBLE PROCESSES. Kloess, Raymond Henry Jr. Syracuse, N. Y., Syracuse Univ., 1966. 77p.

Thesis.

An attempt is made to construct a quantum analog of the Bergmann–Lebowitz model. The uncertainty relation involving time and energy in quantum mechanics prevents one from regarding the system–reservoir interactions as impulsive. Since the assumption of impulsive interactions is essential to the derivation of the Bergmann–Lebowitz equation, their method cannot be transferred directly to a quantum model. (TSS) (Disser. Abstr.)

in line width are obtained as functions of the nuclear spins, the magnetic quantum numbers, the magnetic moments, and of correlation functions defined in terms of the fluctuating spins. (auth)

46428 INFLUENCE OF OXYGEN SEGREGATIONS IN SILICON SINGLE CRYSTALS ON THE HALFWIDTH OF THE DOUBLE-CRYSTAL ROCKING CURVE OF THERMAL NEUTRONS. Eichhorn, F.; Sippel, D.; Kleinstueck, K. (Technische Univ., Dresden. Zentralinstituts fuer Kernforschung, Rossendorf, Ger.). Phys. Status Solidi, 23: 237-40(Sept. 1, 1967).

Oxygen segregations in silicon crystals produced by the Czochralski method are shown to be arranged on "Wendelflächen" by the Schwuttke model. The crystal lattice therefore contains an anisotropic distortion field. A study is made of the effect of this distortion on the half width of double-crystal rocking curves for thermal neutrons. (auth)

46429 A DETERMINATION OF THE FERMI SURFACE OF BERYLLIUM BY THE DE HAAS–VAN ALPHEN TECHNIQUE. Genberg, Richard William. Cleveland, Case Inst. of Tech., 1965. 80p.

Thesis.

In a study of the diamagnetic susceptibility in beryllium using automatic recording of the torque as a function of the reciprocal of the magnetic field at low temperature and low field, six sets of frequencies have been observed. Three sets of frequencies have been attributed to portions of the Fermi surface and show good agreement with the model proposed by B. R. Watts. This model exhibits considerable deviation from the free-electron model. Cyclotron masses have been measured for these three sets of frequencies. Two other sets of frequencies and at least part of the remaining set have been attributed to the nonlinear effects of magnetic interaction. (Disser. Abstr.)

46430 PRESSURE DEPENDENCE OF THE ENERGY OF THE RESONANCE GAMMA RAY OF ^{197}Au AND THE HYPERFINE STRUCTURE COUPLING OF ^{197}Au IN THE ORDERED GOLD–MANGANESE ALLOYS. Patterson, David Owen. Knoxville, Tenn., Univ. of Tennessee, 1966. 115p.

Thesis.

The pressure dependence of the Mössbauer isomer shift of ^{197}Au has been measured at 4.2°K to a pressure of 70.6 kilobars. The shift with respect to metallic gold at zero pressure was fit by the parabola $v_I = 3.78 \times 10^{-3} P - 5.6 \times 10^{-6} P^2$ where v_I is in mm/sec and P is in kilobars. This result is in excellent agreement with that predicted by Roberts et al. The result confirms that in all the gold alloys thus far studied the electronic charge density near the gold nucleus is greater than it is in metallic gold. The hyperfine structure coupling of ^{197}Au in ordered $AuMn_3$, AuMn, Au_2Mn, Au_3Mn, Au_4Mn and solutions containing 0.3 and 1 at. % gold in manganese was measured. The results reflect the crystalline and magnetic structure for the different systems. Values are given for the magnetic field, electric field gradient, and isomer shift for ^{197}Au in the alloys. From the ground state splitting in Au_2Mn, the value of the magnetic moment of the 77.345-keV excited state of ^{197}Au was determined to be $\mu^* = 0.420 \pm 0.004$ nuclear magnetons. The hyperfine structure coupling of ^{197}Au in Au_2Mn was also studied at 15.4 and 31.1 kilobars. The isomer shift and magnetic field at the gold nucleus increased with pressure. (Disser. Abstr.)

46431 STUDIES OF CENTERS PRODUCED IN SAPPHIRE AND RUBY BY GAMMA RADIATION. Philbrick, Charles Russell. Raleigh, N. C., North Carolina State Univ., 1967. 107p.

Thesis.

The centers produced by gamma radiation in sapphire and ruby crystals have been studied using several experimental techniques. The optical absorption of gamma-radiation-induced center bands has been studied using plane polarized light to investigate the optical properties along axes perpendicular and parallel to the C axis. This technique allows determination of the anisotropy of the radiation-produced centers. Optical absorption bands were produced by gamma irradiation in the sapphire samples at approximately 6.0, 5.5, 4.2, and 3.0 eV for absorption measurements with the plane of polarization parallel to the C axis. For absorption measurements with the plane of polarization perpendicular to the C axis, the gamma-radiation-produced bands were found at approximately 6.0, 5.6, 4.55, and 3.1 eV. The optical absorption spectra were resolved into Gaussian curves using a computer reduction. The 6-eV absorption band, which has not previously been reported in gamma-irradiated sapphire, is associated with an electron bound at an interstitial aluminum ion. The band at 3 eV together with its anisotropy were found to correspond well with the prediction of Bartram et al. (1965) based on ESR studies of a center which was attributed to an O^- adjacent to a charge-deficient cation site. The optical absorption studies of the irradiated ruby samples showed that prominent center bands occur at 2.64, 4.30, 5.85 and 6.1 eV. The center bands at 2.64 and 4.3 eV possess negative anisotropy and the 5.84 eV band exhibits positive anisotropy. In addition, the results of studies of glow curve measurements, thermoluminescent emission, electrical conduction and step annealing experiments are reported and discussed for the centers produced in ruby and sapphire crystals by gamma radiation. Also, the thermal activation energies of the sapphire centers have been calculated by three different methods and were found to be in agreement. (Disser. Abstr.)

Theoretical Physics

Refer also to abstracts 46057, 46153, 46499, and 46525.

46432 (N–67-19245) EFFECTS OF THE NODAL REGRESSION OF THE ORBIT ON THE GRAVITY PRECESSION OF A GYROSCOPIC SATELLITE. Myers, James L. Jr. (Illinois Univ., Urbana. Coordinated Science Lab.). July 1966. Contract DA-28-043-AMC-00073(E). 23p. (NASA-CR-82592; R-309). CFSTI.

A gyroscopic satellite has been proposed for a test of the general theory of relativity in which the gyro "drift" rate to be measured is less than seven seconds of arc per year. The Coordinated Science Laboratory has proposed a simple passive gyroscope which uses sunlight reflected from mirrors to provide optical data to determine the spin axis orientation. The gravity gradient torque acting on the satellite is one of several extraneous disturbances which can cause spurious precession of the gyro spin axis. In this paper, general equations for the precession of a gyro satellite in a regressing orbit are derived. These equations may be used to specify the tolerances for initial spin axis and orbit alignments which enable an accurate measurement of the relativity effect. (auth)

46433 (AD–642797) GENERAL RELATIVITY AND QUANTUM THEORY. Final Scientific Report, February 1, 1965–August 31, 1966. Laurent, B. (Stockholm Univ. (Sweden). Inst. of Theoretical Physics). Contract AF61(052)-865. 5p. (AFOSR–66-2699). CFSTI.

A new method to produce gravitational radiation by stimulated emission, using photons as the stimulating particles, is suggested. Such a process should occur in some stars, and it has important possibilities in connection with gravitational lasers. Calculations show that soft gravitational radiation could interact with light more than has hitherto been assumed. The mixed Compton effect and the behavior of superconductors in gravitational fields were also studied as well as a generalization of the 5-dimensional theory to account for PC nonconservation. (auth) (TAB)

46434 (N–67-23082) FIFTY YEARS OF QUANTUM THEORY. Heisenberg, W. Translated by Barbara Crossland (Royal Aircraft Establishment, Farnborough, Eng.), from Naturwissenschaften, 38: 49-55(1951). 15p. (RAE-Lib-Trans–1202). CFSTI.

Quantum theory up to 1950 is reviewed. All the important theories and discoveries are described in a qualitative, sometimes metaphysical, manner. Some insight into the conceptual difficulties encountered by physicists fifty years ago is provided by a description of the author's own work in the field of quantum theory. Every development of the theory is mentioned, though sometimes only briefly. The article provides a starting point for detailed reading of any aspect of quantum theory. (auth)

46435 HOENL–DEHNEN FORMULATION OF MACHIAN PRINCIPLES. Ehlers, J.; Schuecking, E. (Univ. of Texas, Austin). Z. Phys., 206: 483-91(1967). (In German).

It is shown that the classification of curved space–times into Machian and anti-Machian world models proposed by Hönl and Dehnen is inadequate. It is proved that even the static Einstein model would be anti-Machian according to the definition of these authors, in contrast to their assertion. The proof is based on the theorem that any Robertson–Walker space–time admits regular source-free Maxwell fields. (auth)

46436 REPLY TO THE WORK OF J. EHLERS AND E. SCHUECKING ON THE FORMULATION OF MACHIAN PRINCIPLES. Hoenl, H.; Dehnen, H. (Univ., Freiburg i. B.). Z. Phys., 206: 492-502(1967). (In German).

After a short explanation of the viewpoint for general relativistic dynamics the objections of Ehlers and Schuecking against the author's formulation of Machian principles is taken up. (tr-auth)

46437 EQUALITY OF AN EXTERIOR PRODUCT AT UNIVERSAL VECTORS OF A TENSOR ELECTROMAGNETIC FIELD CREATED BY EXACT CHARGE. Boudet, Roger. Compt. Rend., Ser. A and B, 264: 1174-6(June 26, 1967). (In French).

Previous work on the equality of an exterior product of universal vectors of a field produced by $M = x^\mu e_\mu$ ($\mu = 1, 2, 3, 4$, x^μ are Minkowski coordinates of the point M) by an exact charge is considered again in more detail. (J.F.P.)

46438 ALTERNATIVE TO THE ORTHODOX INTERPRETATION OF QUANTUM THEORY. Pearle, Philip (Harvard Univ., Cambridge, Mass.). Amer. J. Phys., 35: 742-53(Aug. 1967).

An alternative calculational procedure for quantum theory is presented, employing three features which differ from the corresponding features of orthodox quantum theory. These are: (1) the state vector is never to be "reduced"; (2) quantum theory only makes predictions about ensembles of identical experiments (not about individual experiments); and (3) the measuring apparatus must always be included in the state vector. What is new about this alternative theory is the demonstration that (2) and (3) (which have hitherto been discussed separately) can be consistently combined to yield an interpretation of quantum theory which has the additional advantage of (1). It is shown that alternative and orthodox theories yield identical predictions for any practical experiment. However, two classes of experiments (which are impractical) for which the orthodox and alternative theories yield different predictions are described. Therefore, it is, in principle, possible to decide which theory nature has chosen to obey. It is concluded that there is no reason, based upon experimental evidence, for preferring one theory over the other. (auth)

46439 "CANONICAL" REPRESENTATIONS OF THE INHOMOGENEOUS LORENTZ GROUP. Lugarini, G.; Pauri, M. (Istituto Nazionale di Fisica Nucleare, Parma, Italy). Ann. Phys. (N.Y.), 44: 266-88(Sept. 1967).

A systematic characterization is given of the basic unitary representations of the inhomogeneous Lorentz group which are of interest in classical mechanics. The study is carried out on the ground of a representation theory for classical mechanics previously proposed. Accordingly, the irreducible representations, in the "classical" Hilbert space of Koopman–von Neumann, which are the proper unitary counterpart of the canonical (phase-space) realizations of the Poincaré group in the neighborhood of the identity ("canonical" representations) are classified and explicitly derived. The irreducible "canonical" representations which can be taken into account from a physical point of view are essentially of three kinds: representations corresponding to free particles of finite rest mass and arbitrarily fixed spin; representations corresponding to particles of zero rest mass pure, arbitrarily fixed, helicity and, finally, other representations describing systems of zero rest mass with a "spin" which depends on the Lorentz frame and can assume any positive real value. Except possibly for the photon, the last two classes can hardly be connected with realistic classical models. The related relativistic Liouville equations of motion are deduced. (auth)

46440 COSMOLOGICAL CONSTANT AND PERIHELION PRECESSION. Alpher, Ralph A. (General Electric Research and Development Center, Schenectady, N. Y.). Amer. J. Phys., 35: 771(Aug. 1967).

The precise and trivial effect of a nonzero cosmological constant on the perihelion of Mercury is shown. (W.D.M.)

46441 RAINICH GEOMETRIZATION OF FERMION FIELDS. Kuchar, K. (Charles Univ., Prague). Wiss. Z. Friedrich-Schiller-Univ., Jena, Math.-Naturwiss. Reihe, 15: 95-9(1966).

The Rainich unification of coupled electromagnetic and gravitational fields introduced a procedure by which an arbitrary wave field can be given a geometrical interpretation within Einstein's original theory. The Rainich problem for the simplest boson fields (neutral and charged scalar fields) has been solved, and the difficulties connected with Rainich geometrization of fermion fields discussed for the neutrino field. A formal geometrization of the neutrino field has been attempted. By the analysis of the procedure used in this attempt, the present author ascertained that the final failure of a complete Rainich geometrization of the neutrino field is caused by the lack of direct geometrical interpretation of spin density tensor, which for the neutrino is determined by a four-current. It is known that during the transcription of spinor equations into curved spaces the Riemannian structure of the space must be enriched by a tetrad field or a field of axiomatically introduced spinor matrices $g^{\mu}AB$. Some recent reports have taken for granted that the spin of a source field has an influence on the new geometrical characteristics. As an example, Kibble's version is examined, in which the spin is connected with the antisymmetric part of affine connection and thereby geometrized. It is shown that the geometrization of the spin offers a natural basis for a full Rainich geometrization of not only the neutrino, but even of the Dirac bispinor field. The results demonstrated that the geometrization of spin within the framework of Kibble's theory enables the complete Rainich geometrization of fundamental fermion fields. (BBB)

46442 SURVEY OF INVESTIGATIONS ON THE ENERGY-MOMENTUM COMPLEX IN GENERAL RELATIVITY. Moeller, C. (Univ. of Copenhagen). Kgl. Dan. Vidensk. Selsk. Mat.-Fys. Medd., 35: No. 3, 14p(1966).

Starting with the well-known expression for the energy–momentum complex $({}_{g}T_{l}^{i} = T_{l}^{i} + {}_{g}t_{l}^{i})$ as formulated by Einstein in his approach to the problem of energy and momentum conservation for the complete system of matter plus gravitational field, various subsequent approaches to this problem are outlined. For a closed system and for a restricted class of coordinate systems, the quantities obtained from ${}_{g}T_{l}^{i}$ by integrating over spatial coordinates are examined. By integrating over a suitable cylindrical region of space–time and using Gauss's theorem it can be shown that these quantities $({}_{g}P_{l})$ have the following properties A, which are essential for the interpretation of P_l as the components of the 4-momentum: (A) For a closed system and in a system of BS coordinates the quantities P_l are constant in time and they transform as the components of a 4-vector under all linear transformations; and (B) For a closed physical system the total 4-momentum is a free 4-vector under arbitrary space–time transformations. A discussion is given of which properties of the energy–momentum complex T_l^i are necessary and sufficient in order that the integrated quantities P_l have all the properties A and B. In any system of BS coordinates, the values of P_l obtained from the tetrad complex are the same as those obtained from the metric complexes of Einstein. Therefore, once the generally covariant expression of P_l has been established by way of the tetrad formalism, the tetrads may be neglected and the calculation made of P_l in a system of coordinates in which the purely metric-dependent complexes are known to be valid. Then, the values of P_l in an arbitrary system of coordinates can be obtained by using the law of transformation of a 4-vector. (BBB)

46443 A RELATIVISTIC VIRIAL THEOREM FOR A SYSTEM OF CHARGED PARTICLES MOVING IN AN EXTERNAL ELECTROMAGNETIC FIELD. Rubin, N. B. Zh. Tekh. Fiz., 37: 1001-5(June 1967). (In Russian).

A relativistic virial theorem is described for a system of charged particles moving in a finite region of space in an external electromagnetic field, expressing the average energy of the particles and the field that they produce as the sum of the averages of two integrals, one of which is taken over the trace of the energy–momentum tensor of the particles alone, and the other involves the currents and the external field. In deriving the theorem, radiation losses were excluded by assuming the system to be enclosed by reflecting walls. The energy associated with the polarization of the material composing the source of the external field (which must be included within the enclosure) was not taken into account, and the theorem is therefore valid only when this energy is small or when radiation can be neglected. The theorem may be of use in the investigation of the behavior of storage rings, accelerators, plasma confinement systems, and other devices. (ATD)

46444 MOTION EQUATIONS OF A MACROSCOPIC ROTATING PARTICLE ACCORDING TO GENERAL RELATIVITY THEORY. Micoulaut, R. (Univ., Freiburg i. B.). Z. Phys., 206: 394-403(1967). (In German).

It is shown that under special covariant constraints the Papapetrou equations of motion of a spinning particle (rotating planet) moving in a spherically symmetric field (Schwarzschild field) give additional terms in the expressions for the advance of perihelion and the deflection angle of particle. (auth)

46445 UNIFIED FIELD THEORY BASED ON A SEMI-SYMMETRIC CONNECTION. George, T. L. (Univ. of Sierra Leone, Freetown). Nuovo Cim. (10), 51A: 664-73(Oct. 1, 1967).

A unified theory of electromagnetism and gravitation is proposed, which seems to be free from some of the difficulties of the other theories. The field equations are simpler and have exact solutions. The static electric field is finite everywhere including the origin; and although the gravitational field is not, yet they both tend to their classical values at large distances from the origin. It is also shown that the "λ transformations" of Einstein are no more than the gauge transformations of the electromagnetic potentials. (auth)

46446 GRAVITATIONAL BOUNCE. de la Cruz, V.; Israel, W. (Univ. of Alberta, Edmonton. Dublin Inst. for Advanced Studies). Nuovo Cim. (10), 51A: 749-50(Oct. 1, 1967).

A solution of Einstein's field equations is derived which represents a thin spherical shell of charged dust falling in the spherically symmetric field of a charged massive body placed at its center. Under suitable conditions the shell bounces reversibly at a nonzero minimal radius. A bounce is still possible even after the shell has collapsed inside the Schwarzschild sphere, so that the collapse as viewed externally is irreversible. The apparent paradox is explained in terms of the lattice-like structure of the analytically extended Reissner–Nordström manifold. The

possible relevance of the results to the problem of realistic gravitational collapse is discussed. (auth)

46447 METHOD OF SMALL PARAMETER FOR RELATIVISTIC ELECTRON IN QUANTUM MECHANICS. Shalbaev, E. B. pp 126-32 of Differentsial'nye Uravneniya i Ikh Primenenie. Amandosov, A. A. (ed.). Alma-Ata, USSR, Izdatel'stvo Nauka Kazakhskoi SSR, 1967. (In Russian).

Previously, Arzhanykh constructed a mathematical algorithm by means of which (using classical mechanics) it was possible to obtain equations for quantum mechanics. The algorithm is universal and offers equations for classical mechanics and for quantum mechanics. An attempt is made to apply the algorithm to the relativistic electron in quantum mechanics. (R.V.J.)

46448 PROBLEMS OF INTERPRETATION OF STATIONARY, RIGID, OR CONFORMABLY RIGID ds^2. Bel, Luis; Escard, Jean C. Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur., 41: 476-86(Dec. 1966). (In French).

The interpretation of a given ds^2 solution of the Einstein equations of space poses the problem of defining the concepts of the gravitational field, space, and time. This can be done by introducing a field of vectors oriented in time. Three cases are considered which correspond respectively to the cases in which this field of vectors is generated by a group of isometry, by a group of rigid motions, and by a group of so-called conformably rigid movements. In these three cases a projection formula is obtained which translates the field equations and the motion equations of test particles in the form of tensor equations to a Riemannian variety with three dimensions. In the first two cases the results are for the most part known and in the present article only some complementary observations are given. In the third case the results indicated are new. In general in all three cases it was possible to show the formal analogy which exists between the projection equations obtained and the Maxwell equations of electromagnetism written in three-dimensional formalism. (tr-auth)

46449 MANY-PARTICLE SYSTEMS. V. ZERO-RANGE INTERACTIONS. Hall, R. L. (London Univ.). Proc. Phys. Soc. (London), 91: 787-93(Aug. 1967).

Close upper and lower bounds are found on the binding energy of a system of N identical bosons interacting in one dimension by an attractive square-well pair potential. In the limit in which the potential has the shape of a δ function the bounds are found to be consistent with McGuire's [J. Math. Phys., 5: 622-36(1964)] exact solution. In three dimensions the limit of vanishingly small range, in which the two-particle binding energy is kept constant, gives infinite binding to the N-particle system, in agreement with Thomas's theorem. Consideration of other limiting process eliminates an apparent contradiction between Thomas and Svartholm. (auth) (UK)

46450 REMARK ON THE INITIAL VALUE PROBLEM OF THE EINSTEIN-MAXWELL FIELD. Langer, J. (Charles Univ., Prague). Czech. J. Phys., 17: 653-6(1967).

The initial value problem for the coupled gravitational and non-null electromagnetic fields is considered with the result that $g_{\mu\nu}$ and $g_{\mu\nu 0}$, specified almost freely on an initial space-like hypersurface, can always be interpreted as the geometrical initial data for the case considered. (auth)

46451 THE LORENTZ GROUP: AXIOMATICS-GENERALIZATIONS-ALTERNATIVES. Strauss, M. (Deutsche Akademie der Wissenschaften, Berlin). Wiss. Z. Friedrich-Schiller Univ., Jean, Math.-Naturwiss. Reihe, 15: 109-18(1966).

The two principles used by Einstein to establish the Lorentz group and the necessity of using them for this purpose are examined. It is pointed out that no equivalent substitute for the special theory of relativity exists, only nonequivalent alternatives. The second principle is correct but not required for the axiomatic foundation of the theory. Of the first principle only the weak implication is essential for kinematics; it amounts to little more than a definition of the uniform motion equivalence. The empirical content of the theory lies mainly in the possibility that it excludes: unlimited speed and the wrong sign of c^2, the double world implied by Gordon and Placios. The interrelation of speed and simultaneousness in their summation is irrelevant to the theory; it is based on an arbitrary and incomplete operational definition of velocity and does not appear in the final theory. If constant velocity is taken as a primary concept characterized by a set of postulates, the Lorentz group emerges as the mathematical expression of the uniform motion equivalence. There is one genuine generalization of the special theory, the general theory; this theory is more general because it includes gravitation. (BBB)

46452 DERIVATIVE METHOD IN MANY-BODY THEORY. Marburger III, John Harmen. Stanford, Calif., Stanford Univ., 1967. 142p.

Thesis.

The normal ordering techniques of Louisell, Walker and Heffner, previously restricted to systems described by hamiltonians at most quadratic in boson creation and annihilation operators, are here extended to the case of anticommuting operators and self-interacting systems. These techniques are closely related to the method of functional derivatives in quantum field theory, and the term "derivative method" is used here to emphasize this connection. This method is used to compute approximate expressions in normal form for the second quantized time evolution and density operators for systems of interacting particles. Extension of the method to anticommuting variables is accomplished by specializing the "anticommuting c-number" formalism of the functional derivative method and treating the derivatives so obtained in the same way as those appearing in boson normal ordering prescriptions. The need for modifications of the method for nonquadratic hamiltonians is shown by using the properties of derivative operators to prove that in this case closed solutions in normal form for the time evolution and density operators do not exist. In this case, the method presented here leads to an infinite coupled set of differential equations for certain coefficients appearing in the solutions. A physical interpretation for these coefficients is found by comparing the exponential trial function involved in the derivative method with the result of a "connected diagram theorem" which is presented here in a form somewhat more general than usual. This comparison shows in the case of the time evolution operator that the coefficients in question are equal to sums of connected diagram contributions. A similar formalism for the fourier transform of the density operator (characteristic function) leads to a system of equations for cumulant averages of products of the creation and annihilation operators. In both cases the infinite system may be truncated by ignoring higher order connected or cumulant terms. This procedure is similar to one employed in the theory of Green's functions whose relation to the method presented here is described briefly. Several problems are discussed in the context of the derivative method to illustrate the formalism. (Disser. Abstr.)

46453 LES THEORIES UNITAIRES DE L'ELECTROMAGNETISME ET DE LA GRAVITATION. (Unitary Theories of Electromagnetism and Gravitation). Tonnelat, Marie-Antoinette. Traite de Physique Theorique et de Physique Mathematique, XI. Paris, Gauthier-Villars, 1965. 545p.

The principles of the Maxwell electromagnetic theory and of general relativity theory are summarized. The classical unitary theories are then analyzed. The theories based on the use of Riemannian spaces with more than four dimensions are first considered. Classical unitary theories based on the use of non-Riemannian spaces with four dimensions are then discussed. General relativity in its relation with the electromagnetic theory and the quantum formalism is considered in the last section. The book is designed for students and new researchers. (J.S.R.)

46454 STATISTICAL THEORY OF CHARGED PARTICLE TRANSPORT IN DISORDERED MAGNETIC FIELDS. Roelof, Edmond Charles. Berkeley, Calif., Univ. of California, 1966. 225p.

Thesis.

The motion of a charged particle in a time-independent, spatially disordered magnetic field where particle and field parameters are such that the particle undergoes a "magnetic Brownian motion" is studied. This motion, where the variations in displacement are due to the cumulative effects of small Markovian random velocity fluctuations, leads to a true spatial diffusion process which becomes anisotropic when the mean part of the magnetic field significantly exceeds the root-mean-square random part. The critical parameter is the "relaxation time" (T) in which the velocity distribution, derived from the solution to a Fokker-Planck equation, relaxes to an asymptotic form independent of the initial distribution. The relaxation time is inversely proportional to the spatial power spectrum evaluated at the wavenumber equal to the inverse of the particle's relativistic gyro-radius in the mean field. The diffusion coefficient along the mean field is $\cong v^2T/6$ (where v is the particle velocity) and in the anisotropic case the ratio of the parallel to the transverse diffusion coefficient goes like the square of the number of gyrations (in radians) the particle makes in the mean field during one relaxation time (T). In the special case where the mean magnetic field is significantly greater than the root-mean-square random part of the field, the statistical parameters may be allowed to be weak functions of position, i.e., if the spatial dependence of the parameters can be characterized by the scale length (L) of the mean field and $vT < L$. The velocity anisotropy parameter $k \equiv vT/2L$ then determines the asymptotic velocity distribution which peaks along the field line in the direction of decreasing field strength. The theoretical velocity distribution is compared with the proton flux anisotropies measured by Pioneer VI for the event of December 30, 1965. An appropriate one-dimensional diffusion equation is derived in curvi-

linear coordinates and it is shown that agreement with observed time histories of solar proton events implies a position-dependent diffusion coefficient which is a functional of the mean magnetic field. With Parker's spiral quiet-day field as a model for the mean field, the spatial variation of the diffusion coefficient and other propagation parameters is inferred for radial distances between 0.1 and 10 AU. The spatial power spectrum of the magnetic field at 1 AU is derived from the diffusion coefficients obtained from proton observations over the past decade and is compared with the power spectrum obtained from the magnetic-field measurements of Mariner 2. By using the energy and spatial dependence of the diffusion coefficients for the solar proton event of September 28, 1961, the power spectrum deduced from that event is transformed into the spectrum at positions elsewhere in the solar system. The diffusion-like solar electron events of 1965 are discussed, but agreement with theory is less satisfactory than for solar proton events. Some suggestions are offered to explain the discrepancy. (Disser. Abstr.)

46455 QUANTUM MODEL OF IRREVERSIBLE PROCESSES. Kloess, Raymond Henry Jr. Syracuse, N. Y., Syracuse Univ., 1966. 77p.

Thesis.

An attempt is made to construct a quantum analog of the Bergmann–Lebowitz model. The uncertainty relation involving time and energy in quantum mechanics prevents one from regarding the system–reservoir interactions as impulsive. Since the assumption of impulsive interactions is essential to the derivation of the Bergmann–Lebowitz equation, their method cannot be transferred directly to a quantum model. (TSS) (Disser. Abstr.)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

46456 (NYO-1984-11) HIGH ENERGY PHYSICS AT TUFTS UNIVERSITY. Progress Report, September 1967. Knipp, J. K. (Tufts Univ., Medford, Mass.). Contract AT(30-1)-1984. 14p. Dep. CFSTI.

Brief summaries of experimental work on high energy particle interactions completed or in progress are given. Also proposed experiments are described. Instrumentation development work for bubble chambers and spark chambers is discussed. Also laser beam studies are described. (J.F.P.)

46457 STUDY OF THE FRACTIONAL CHARGE CONTENT OF THE COSMIC RADIATION. Buhler-Broglin, A.; Dalpiaz, P.; Massam, T.; Zichichi, A. (CERN, Geneva, Univ., Bologna. Istituto Nazionale di Fisica Nucleare, Bologna. Institut de Recherches Nucleaires, Strasbourg). Nuovo Cim. (10), 51A: 837-45(Oct. 1, 1967).

An analysis of the fractional charge content of the cosmic radiation at 450 m above sea level is reported. The following upper limits are established: number of fractional charges $(\pm 1/3)e < 4.5 \cdot 10^{-10}$ cm^{-2} sr^{-1} s^{-1} with 90% confidence level, number of fractional charges $(\pm 2/3)e \leq (1.7 \pm 1.7) \cdot 10^{-10}$ cm^{-2} sr^{-1} s^{-1}, number of fractional charges $(\pm 4/3)e \leq (1.6 \pm 0.8) \cdot 10^{-7}$ cm^{-2} sr^{-1} s^{-1}. (auth)

Electromagnetic

46458 PROGRAM FOR PROCESSING PENETRATING SHOWERS ON THE BESM-2 UNIVERSAL COMPUTER. Zhorzholadze, T. Sh.; Meladze, O. B.; Tarkashvili, Ts. T.; Shengeliya, L. G. pp 116-29 of Yadernye Vzaimodeistviya pri Vysokikh Energiyakh. Tbilisi, USSR, Metsniereba Publishing House, 1966. (In Russian).

The program for finding the place of shower generation is a continuation of a program in which the values characterizing each track are determined individually and which has two parts, in the first of which the point of convergence of all tracks is found and then the point of convergence upon successive exclusion of 1, 2, . . ., n tracks, to eliminate irrelevant tracks. Here each track is approximated by a parabola and the point of convergence is at the intersection of the tangents at the point where particles enter the chamber. The point of generation is determined more precisely in the second part. There is a separate program for finding the point of shower generation directly from measured input data. (JPRS)

46459 POLARIZATION OF RECOIL PROTONS FROM THE PHOTOPRODUCTION OF ETA-MESON. Kobayakawa, Hisashi. (Nagoya Univ., Japan). J. Phys. Soc. Jap., 23: 684-90(Oct. 1967).

The polarization of recoil protons from the reaction $\gamma + p \rightarrow p + \eta^0$ was measured for eta center of mass angle of 107.5° at 890 MeV γ-ray energy. The decay γ-rays from η^0 were detected by a lead glass Cherenkov counter in coincidence with a recoil proton. Recoil proton polarization was measured by analyzing the scattering asymmetry in a carbon plate spark chamber. According to Minami's theoretical analysis for the interpretation of the eta-nucleon system, the obtained value of the polarization $P = 0.54 \pm 0.40$ is suggesting that the contribution of the interaction in the $S_{\frac{1}{2}}$ state is predominant over that in the $D_{\frac{3}{2}}$ state. (auth)

46460 INVESTIGATION OF THE ρ-MESON RESONANCE WITH ELECTRON-POSITRON COLLIDING BEAMS. Auslander, V. L.; Budker, G. I.; Pestov, Yu. N.; Sidorov, V. A.; Skrinskii, A. N.; Khabkhpashev, A. G. (Inst. of Nuclear Physics, Novosibirsk, USSR). Phys. Lett., 25B: 433-5(Oct 2, 1967).

Preliminary results on the determination of the position and shape of the ρ-meson resonance with electron-positron colliding beams are presented. (auth)

46461 SEARCH FOR THE DECAY MODE $\eta^0 \rightarrow \pi^0 e^+ e^-$. Billing, K. D. (University Coll., London); Bullock, F. W.; Esten, M. J.; (and others). Phys. Lett., 25B: 435-9(Oct. 2, 1967).

In an effective sample of 6300 η^0 (549) mesons, no positively identified example of the $\pi^0 e^+ e^-$ decay mode has been found. With 90% confidence the branching ratio for this mode is less than 3.7×10^{-4} of all η^0 decays. (auth)

46462 NEUTRAL MESON PHOTOPRODUCTION FROM HYDROGEN AT FORWARD ANGLES IN THE PHOTON ENERGY RANGE 750 TO 1500 MeV. Hatch, George Laurie. Pasadena, Calif., California Inst. of Tech., 1967. 109p.

Thesis.

Measurements were made of the cross sections for neutral meson photoproduction from protons at angles in the forward hemisphere for photon energies near 911, 1182, and 1390 MeV. The experimental method consists of detecting the decay gamma rays of the neutral meson in two Pb-glass total absorption Cherenkov counters. The results agree very well with the existing data where the same points were measured. The striking feature of the angular distributions at 1182 and 1390 MeV is the small 0° cross section and the peak near 30 to 40° in the CMS. Using as a model for the cross section calculation a vector meson X^0 exchange plus background the product $\Gamma(X^0 \rightarrow \pi^0 + \gamma) \times (\gamma^2_X NN/4\pi) \simeq 1.8 \pm 0.2$ MeV is found for $M_X = 788$ MeV. Fits made without the vector meson pole are not inconsistent with a resonance model for the cross section. (Disser. Abstr.)

46463 ELECTROMAGNETIC INTERACTIONS OF 16.2-BeV NEGATIVE PIONS. Kinzer, Robert Lee. Norman, Okla., Univ. of Oklahoma, 1967. 155p.

Thesis.

A nuclear emulsion investigation of electromagnetic interactions of 16.2 BeV negative pions is performed. The emulsion stack is part of the Berkeley stack exposed at CERN. A study is made of the processes of pion-electron scattering (knock-on electron process) and of the direct production of high-energy electron-positron pairs by pions. Data collected is obtained using along-the-track scanning at a scanning rate of ≃23 cm./hr 903 m of track is examined. One hundred fifty-five knock-on electron interactions with electron energies ≥50 MeV are analyzed, although low scanning efficiency at electron energies ≤150 MeV cause the use of cutoff energies greater than 50 MeV. Electron energies were determined by applying kinematics to the two body pion-electron collisions. A scanning efficiency of 65% is determined for location of knock-on electrons with electron energies ≥100 MeV. Agreement, within statistical errors, is found above 200 MeV electron energy with the theoretical results of Salecker, who has made a lowest order quantum electrodynamical calculation for the cross section for production of knock-on electrons. Small statistics limit the conclusions which can be drawn. Direct production of electron-positron pairs by the 16.2 BeV pions is studied in a similar manner. Scanning efficiencies are determined to be ≃83% for locating the electron pair interactions. Ninety-nine such pairs, with total electron plus positron energies ≥10 MeV, were located in 903 m of track. Ninety interactions had energies ≥20 MeV, the lower cutoff energy used in comparisons with theory. Possible sources of error in selecting pair interactions are considered theoretically and experimentally. A 3% correction from background gamma ray conversion within one micron of the tracks is found. Other sources of selection error are negligible. Electron energies in the pair events are measured using the method of multiple Coulomb scattering as given by Barkas and modified by Burwell. This method of energy measurement is evaluated by measuring a spectrum of energies of knock-on electrons representative of the energies measured for pairs and comparing these energies with those determined by kinematics for the same tracks in the pion-electron scattering. Reliability of the scattering method is established with energies measured having a high probability of being within error or slightly less than the actual energies. Comparison is made with the pair production cross section calculations of Ternovskii, Murota et al., Zapolsky, and Bhabba. All calculations except that of Ternovskii consider spin ½ primaries only. Theoretical results for spin ½ primaries are shown to be equivalent, within the approximations made, to those for spin 0 primaries at the energies of interest in this investigation. The theoretical results are in considerable disagreement with experimental results. Agreement is found between experiment and the results of Ternovskii and of Murota et al., at total pair energies between 20 and 60 MeV. Above this energy region a disagreement which increases with energy is found. Above 100 MeV pair energy the experimental total cross section, not corrected for experimental errors, is ≃2½ times larger than the theoretical cross section. Above 140 MeV the ratio is three. Since most of the possible experimental errors tend to minimize the disagreement between theory and experiment, a need for a more accurate calculation of the cross section is indicated. (Disser. Abstr.)

46464 MEASUREMENTS OF THE NEUTRON ELECTROMAGNETIC FORM FACTORS. Binkley, Morris Edward Jr. Ithaca, N. Y., Cornell Univ., 1966. 94p.

Thesis.

Investigations were made of the electromagnetic neutron form factors at momentum transfers of 5.5, 10.0, and 14.5 F^{-2} by measuring the differential cross sections for quasi-elastically scattered electrons by deuterium in coincidence with a scattered nucleon in the reaction e + d → e + p + n. This was done by measuring the ratio of the differential cross section $d^3\sigma/d\Omega_e d\Omega_n$ to the differential cross section $d^3\sigma/dE_e d\Omega_e e\Omega_p$ for two different electron scattering angles for each value of the momentum transfer q^2. Durand has shown that the ratio of these differential cross sections from deuterium is nearly equal to the ratio of the differential cross sections for free electron–neutron and electron–proton scattering. This result is relatively insensitive to assumptions made about the wave function of the deuteron. The most important result is for G_{en}^2 since its value is very insensitive to the absolute efficiency and solid angle of the neutron counter. For all three momentum transfers results are obtained consistent with $G_{en}^2 = 0$. (Disser. Abstr.)

Weak

46465 (COO-1195-100) MEASUREMENT OF THE TWO-PHOTON DECAY OF THE K_L^0 MESON. Todoroff, John Andrew (Illinois Univ., Urbana. Dept. of Physics). Aug. 1967. Contract AT(11-1)-1195. 149p. Dep. CFSTI.

Thesis.

The decay $K_L^0 \rightarrow 2\gamma$ has been observed and the branching ratio has been measured in a spark chamber-counter experiment. A branching ratio roughly consistent with a model for $K_L^0 \rightarrow 2\gamma$ in which the decay proceeds through virtual π^0 and η^0 states was obtained. However, the calculation with this model depends strongly on the unmeasured absolute rate of $\eta^0 \rightarrow 2\gamma$ and close comparison with this theory must await a good measurement of the η^0 lifetime. The measurement was performed on a beam of K_L^0's of a mean momentum of 1.0 BeV/c. The beam, 10.5 cm. wide × 15 cm. high, passed through a detection system that was sensitive to the decays over a length of about one meter. Decay photons from $3\pi^0$, $2\pi^0$, and 2γ events converted and initiated showers in lead plates within two symmetrically placed spark chambers. Shower energies were measured with an average resolution of ±30% with lead-and-scintillator total absorption counters behind each spark chamber. These energies ranged from 0.4 to 1.2 BeV. An "event" required at least one photon conversion in each spark chamber. Stereoscopic pictures were taken of the showers of each event. Pictures were selected which showed only two showers and both of well-defined direction. These pictures were measured and each event was reconstructed in space by the use of a computer. The two photon energies and angles were then compared with the kinematics for a $K_L^0 \rightarrow 2\gamma$ decay. Monte Carlo simulation of $3\pi^0$ and $2\pi^0$ decays showed the fit to $K_L^0 \rightarrow 2\gamma$ kinematics that could be expected from events of these modes in which only two of the photons were detected. The background closest to simulating $K_L^0 \rightarrow 2\gamma$ kinematics arose from $3\pi^0$ events in which only two photons converted in the spark chambers but one or more additional photons entered the shower absorption counters and added in their energies. Comparison of the fit to 2γ kinematics of the experimental and Monte Carlo events has allowed subtraction of the $3\pi^0$ and $2\pi^0$ background and identification of 32 ± 8 $K_L^0 \rightarrow 2\gamma$ events. The presence of two decay charged particles in coincidence was detected as a count of the sum of all the principal charged modes ($\pi^\pm e^\pm \nu$, $\pi^\pm \mu^\pm \nu$, $\pi^+\pi^-\pi^0$). Since these charged modes have well-measured branching ratios, their count was used to determine the total number of K_L^0's decaying in the beam. Detection efficiencies for each charged and neutral decay mode were calculated by Monte Carlo techniques. Using these efficiencies, together with the total number of charged coincidences and the 32 events identified as $K_L^0 \rightarrow 2\gamma$, a branching ratio, relative to all modes, of $(6.7 \pm 2.2) \times 10^{-4}$ was obtained. The experiment is not capable of a positive identification of $K_L^0 \rightarrow 2\pi^0$ events at a branching ratio as small as is now known. It is calculated that around seven $2\pi^0$ events would appear in our sample of 2γ events and about another nine among our large $K_L^0 \rightarrow 3\pi^0$ background. Neither group of $2\pi^0$'s is large enough to be distinguished from the statistical fluctuation of the 2γ, or $3\pi^0$ samples. However, a $2\pi^0$ background was subtracted in reaching the best estimate of the number of 2γ events. (auth)

46466 (NEVIS-162) MEASUREMENT OF THE CHARGE ASYMMETRY IN THE DECAY OF $K_L^0 \rightarrow \pi^\pm + e^\mp + \nu$. Bennett, Sheldon; Nygren, David; Saal, Harry; Steinberger, Jack; Sunderland, John (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Labs.). 1967. Contract AT(30-1)-1932. 14p. (CU-1932-266). Dep. CFSTI.

The charge asymmetry $\delta = (\Gamma_+ - \Gamma_-/\Gamma_+ + \Gamma_-)$ for the electron in the decay of the long-lived neutral kaon to pion, electron, and neutrino was measured. An asymmetry $\delta = (+2.24 \pm 0.36) \times 10^{-3}$ was found. The result shows that CP symmetry is violated in this process. (auth)

46467 (UCRL-17746) MEASUREMENT OF THE Σ^+ MAGNETIC MOMENT. Mast, Terry S.; Alston-Garnjost, Margaret; Bangerter, Roger O.; (and others) (California Univ., Berkeley. Lawrence Radiation Lab.). Aug. 15, 1967. Contract W-7405-eng-48. 6p. (CONF-670934-3). Dep. CFSTI.

From International Conference on Elementary Particles, Heidelberg, Germany.

The Σ^+ magnetic moment was measured by observing the precession of polarized sigmas in the magnetic field of the hydrogen bubble chamber. From an exposure of 1.2 $(10)^6$ pictures, 31,000 events of the type $K^- + p \rightarrow \Sigma^+ + \pi^-$, $\Sigma^+ \rightarrow p + \pi^0$ were analyzed. The incident momenta range from 340 to 430 MeV/c. (J.F.P.)

46468 (UCSD-10P10-103) MAGNITUDE AND SIGN OF THE K_1^0-K_2^0 MASS DIFFERENCE. Murty, Susarla Suryanarayana (California Univ., La Jolla, San Diego). 1967. Contract AT(11-1)-Gen-10. 140p. Dep. CFSTI.

Thesis.

The magnitude and sign of the mass difference $\delta = M_{K_2^0} - M_{K_1^0}$, where K_1^0 and K_2^0 are superpositions of the neutral K^0 and $\bar{K}^0$ mesons, are studied. The method used to investigate this consists in producing a K^0 beam, by charge exchange of a K^+ beam, at time zero. The K^0 beam, after a certain time, passes through a stainless steel regenerator. At the exit of the regenerator, the beam contains the originally produced but attenuated K_2^0 beam and a K_2^0 regenerated K_1^0 beam. The phase of these two waves depends on the distance from the source to the regenerator, multiplied by the mass difference, δ. The interference effects of the common decay mode ($\pi^+\pi^-$) were studied, by varying the distance between the source and the regenerator, and have obtained the following results: proof that the two waves decay into quantum mechanically identical states; the magnitude of the mass difference is +0.46 ± 0.02, and K_2^0 is heavier than K_1^0. (auth)

46469 (UCSD-10P10-104) SIGN OF THE MASS DIFFERENCE OF NEUTRAL KAONS. Mehlhop, W. A. W.; Good, R. H.; Piccioni, O.; Swanson, R. A.; Murty, S. S.; Burnett, T. H.; Holland, C. H.; Bowles, P. (California Univ., La Jolla, San Diego). Sept. 1967. Contract AT(11-1)-Gen-10. 13p. (CONF-670934-4). Dep. CFSTI.

From International Conference on Elementary Particles, Heidelberg, Germany.

In order to discuss the reliability of the determination of the sign of the mass difference of neutral mesons (K), the evidence for the value of the regeneration amplitude and phase used is considered in detail. These values are derived from a scattering experiment using mesons (K^+) and (K^-). Both the elastic differential scattering and the reaction cross section were measured separately. The value of the real and imaginary potentials for the nuclei for positive and negative mesons (K) of a momentum equal to the most probable K^0 momentum in the regeneration experiment was then determined. The values obtained for the various potentials, the amplitudes for elastic scattering and for the regeneration are given. (J.F.P.)

46470 MEASUREMENT OF THE MUON NUCLEAR CAPTURE RATE IN THE μp MESOATOM. Alberigi Quaranta, A. (Univ., Bologna. Istituto Nazionale di Fisica Nucleare, Bologna); Bertin, A.; Matone, G.; Palmonari, F.; Placci, A.; Dalpiaz, P.; Torelli, G.; Zavattini, E. Phys. Lett., 25B: 429-32(Oct. 2, 1967).

Preliminary results of an experiment to determine the rate of the capture process $\mu^- + p \rightarrow n + \nu_\mu$ are given. (auth)

46471 MEASUREMENT OF THE CHARGE ASYMMETRY IN THE DECAY $K_L^0 \rightarrow \pi^\pm + e^\mp + \nu$. Bennett, Sheldon; Nygren, David; Saal, Harry; Steinberger, Jack; Sunderland, John (Columbia Univ., New York). Phys. Rev. Lett., 19: 993-7(Oct. 23, 1967).

The charge asymmetry $\delta = (\Gamma_+ - \Gamma_-)/(\Gamma_+ + \Gamma_-)$ for the electron in the decay of the long-lived neutral kaon to pion, electron, and neutrino was measured. Asymmetry $\delta = (+2.24 \pm 0.36) \times 10^{-3}$ was found. The result shows that CP symmetry is not conserved in this process. (auth)

46472 CHARGE ASYMMETRY IN THE MUONIC DECAY OF THE K_2^0. Dorfan, D.; Enstrom, J.; Raymond, D.; Schwartz, M.; Wojcicki, S. (Stanford Univ., Calif.). Phys. Rev. Lett., 19: 987-93(Oct. 23, 1967). (SLAC-PUB-346; ITP-281).

The observation and measurement of a charge asymmetry in the muonic decay of the meson (K_2^0) are reported. In particular, it is found that the decay rate $R_{\mu+}$ into $\pi^- + \mu^+ + \nu$ is larger than the decay rate $R_{\mu-} \rightarrow \pi^+ + \mu^- + \nu$ with the ratio determined as $R = R_{\mu^+}/R_{\mu^-} = 1.001 \pm 0.0027$. This result is a prima facie demonstration of CP noninvariance in K_2^0 decay. (J.F.P.)

46473 MEASUREMENT OF THE BRANCHING RATIO FOR THE DECAY $K^+ \rightarrow e^+ + \nu$. Botterill, D. R.; Brown, R. M.; Corbett, I. F.; (and others) (Nuclear Physics Lab., Oxford). Phys. Rev. Lett., 19: 982-5(Oct. 23, 1967).

The decay rate for the mode $K^+ \rightarrow e^+ + \nu$ was measured. There are ten events, which include an estimated 0.34 background event only, and the branching ratio relative to $K^+ \rightarrow \mu^+ + \nu$ is found to be $R = 1.9^{+1.9}_{-0.8} \times 10^{-5}$. This is in good agreement with the prediction of the V−A theory, which is $R = 2.10 \times 10^{-5}$, including radiative corrections. (auth)

46474 Σ^- DECAY PARAMETERS. Berley, D. (Brookhaven National Lab., Upton, N. Y.); Hertzbach, S.; Kofler, R.; Meisner, G.; Shafer, J. B.; Yamamoto, S.; Heintzelman, W.; Schiff, M.; Thompson, J.; Willis, W. Phys. Rev. Lett., 19: 979-82(Oct. 23, 1967).

The decay parameters of $\Sigma^- \rightarrow n + \pi^-$ were measured. It was found that $\alpha_- = -0.104 \pm 0.04$. Defining φ by $\beta_- = (1-\alpha_-^2)^{-\frac{1}{2}}\sin\varphi$, $\gamma_- = (1-\alpha_-^2)^{-\frac{1}{2}}\cos\varphi$, it is found that $\varphi = -22° \pm 30°$, i.e., the decay occurs mainly through the S-wave channel. (auth)

46475 A MEASUREMENT OF THE DECAY ASYMMETRY OF Σ^- HYPERONS AND ITS APPLICATION TO THE $|\Delta I| = \frac{1}{2}$ RULE. Wolf, Sanford Elliot. New York, Columbia Univ., 1963. 31p.

Thesis.

A measurement of the decay asymmetry of Σ^- hyperons gives the result $|\alpha^-\bar{\beta}| = 0.01 \pm 0.16$. The Σ^- hyperons were produced in deuterium by the reaction $\pi^- + n + (p) \rightarrow \Sigma^- + K^0 + (p)$ at an incident momentum of 1220 MeV/c; the resulting Σ^- polarization was expected to be large based on the large Σ^- polarization found in previous experiments using the charge symmetric reaction $\pi^+ + p \rightarrow \Sigma^+ + K^+$. More recent evidence, however, places some doubt on this assumption. The $|\Delta I| = \frac{1}{2}$ rule, together with experimental evidence on the two modes of Σ^+ decay, predicts that no asymmetry should be observed in Σ^- decay. The results of this and other experiments are shown to be consistent with this prediction, although none is conclusive. Recent measurements of the decay $\Sigma^+ \rightarrow p + \pi^0$ may indicate a small discrepancy with the $|\Delta I| = \frac{1}{2}$ predictions; the effect of a small admixture of $|\Delta I| = \frac{3}{2}$ is considered. (Disser. Abstr.)

46476 HYDROGEN BUBBLE CHAMBER STUDY OF K_L DECAYS AND K_S REGENERATION. Firestone, Alexander. New Haven, Yale Univ., 1967. 129p.

Thesis.

The 80-inch liquid hydrogen bubble chamber was exposed to a beam of neutral K mesons produced from a 7 BeV/c π^- beam striking an aluminum target at the Brookhaven AGS. The distance from the target to the center of the bubble chamber was 31 feet. Approximately five K mesons were incident in the chamber per pulse, and about 190,000 exposures were taken of which about $\frac{2}{3}$ have been analyzed. The shape of the incident momentum spectrum is determined from a sample of $K_L \rightarrow \pi^+\pi^-\pi^0$ decays in which both γ-rays from the decay of the π^0 produced showers in a 1.5 radiation length tantalum plate. Data are presented on the differential and total cross sections for the reaction, $K_L p \rightarrow K_S p$, which indicate a negligible real part of the forward scattering amplitude above 2 BeV/c. The average cross section above 2 BeV/c is 46.0 ± 10.4 μb. The evidence for the decay $K_L \rightarrow \pi^+\pi^-$ consists of a 2.7 standard deviation effect above all incoherent and regenerated coherent background in the "forward regeneration region." The phase angle of the amplitude ratio was measured:

$$\frac{\text{Amplitude for } K_L \rightarrow \pi^+\pi^-}{\text{Amplitude for } K_S \rightarrow \pi^+\pi^-} = |\eta_\pm| \exp(i\phi_\eta), \text{ and found}$$

$$\phi_\eta = +30° \pm 60° \text{ if } M_{K_L} > M_{K_S}$$

A sample of 416 $K_L \rightarrow \pi e \nu$ decays were identified using electron detection by shower production in the tantalum plate. (Disser. Abstr.)

Strong (Baryon-Induced)

Refer also to abstracts 46661 and 46665.

46477 MEASUREMENTS OF 1 GeV PROTON TOTAL SCATTERING CROSS SECTION ON H, He, ^{6}Li, C, O, AND Pb TARGETS. Igo, G. J. (Los Alamos Scientific Lab., N. Mex.); Friedes, J. L.; Palevsky, H.; Sutter, R.; Bennett, G.; Simpson, W. D.; Corley, D. M.; Stearns, R. L. Nucl. Phys., B3: 181-7(1967).

Total cross sections have been measured for H, He, ^{6}Li, C, O and Pb targets for 1 GeV incident energy protons. From the differential elastic scattering data published elsewhere, the total elastic scattering and reaction cross sections for H, He, C and O were also obtained. When the data are combined with other measurements in the same energy region, it is found that the total and reaction cross sections can be fit by the formulas $\sigma_T = 47\ A^{0.82}$ and $\sigma_R = 42\ A^{0.67}$ mb. It is also observed that the total and reaction cross sections for negative pions on nuclei can also be fit with these same A-dependencies. (auth)

46478 ANNIHILATIONS OF 3.0 AND 3.6 GeV/c ANTIPROTONS INTO SIX OR MORE PIONS. Danysz, J. A.; French, B. R.; Simak, V. (CERN, Geneva). Nuovo Cim. (10), 51A: 801-19 (Oct. 1, 1967).

A study is reported of the reactions $\bar{p}p \rightarrow n\pi^+ + n\pi^- + m\pi^0$ at 3.0 GeV/c and 3.6 GeV/c ($E_{c.m.s.}$ is equal to 2.77 GeV and 2.96 GeV respectively) where n = 3, 4, or 5 and m ≥ 0. The sample contains 1988 six-prong events at 3.0 GeV/c, 440 eight-prong events at 3.0 and 3.6 GeV/c and 10 ten-prong events at 3.0 and 3.6 GeV/c. The cross sections for various processes observed are compared with the cross sections obtained in other experiments at different incident antiproton momenta. A maximum in the 7π annihilation cross section is seen at a c.m.s. energy of about 2.7 GeV. Appreciable production of ρ^0 in the six-pion events and of $\rho^{0\pm}$ and ω^0 mesons in the seven-pion events is observed. In the six-pion events the $2\pi^+2\pi^-$ mass distribution and the $\rho^0\pi^+\pi^-$ mass distribution show evidence of structure with peaks at (1704 ± 10) MeV and (1834 ± 10) MeV. In the seven-pion events selected to contain a $\pi^+\pi^-$ and $\pi^+\pi^-\pi^0$ mass combination in the ρ^0 and ω^0 regions respectively, the $\rho^0\pi^\pm$ mass distribution shows peaks in the mass regions corresponding to the A_1 and A_2 mesons with masses of (1054 ± 7) MeV and (1269 ± 9) MeV respectively, the width of the peak in the region of the A_2 being smaller, (38 ± 19) MeV, than that usually observed in bubble chambers but is compatible with the lower-mass peak of the split A_2 as observed by Levrat et al. The $\rho^0\omega^0$ mass distribution shows two peaks at masses of (1689 ± 10) MeV and (1848 ± 11) MeV. The angular distributions of pions are slightly collimated along the direction of the incident particles, this collimation being an increasing function of pion momentum in the c.m.s. The ρ^0 and ω^0 mesons also have anisotropic distributions in the c.m.s. A strong angular correlation is observed between pairs of pions of opposite charge. This correlation decreases with increasing energy of the c.m.s. or when the number of π^0 produced in the annihilation increases. (auth)

46479 ELASTIC Λ−PROTON SCATTERING FROM 400 TO 1300 MeV/c. Cline, D.; March, R.; Sheaff, M. (Univ. of Wisconsin, Madison). Contract AT(11-1)-881. Phys. Lett., 25B: 446-8(Oct. 2, 1967). (COO-881-21).

Λ-proton elastic scattering from momenta of 400 to 1300 MeV/c was studied using Λ's produced in hydrogen and deuterium bubble chambers exposed to a K^- beam of momentum ~ 1 GeV/c. 78 elastic Λp scatters were observed. The absolute cross section is estimated. The angular distribution for elastic scattering is consistent with isotropy throughout this region. (auth)

46480 AZIMUTH ANGULAR DISTRIBUTION OF SHOWER PARTICLES IN 24 AND 27 GeV/c PROTON INTERACTIONS IN NUCLEAR EMULSIONS. Rao, G. K.; Kamal, A. A. (Osmania University, Hydersabad, India). Proc. Phys. Soc. (London), 91: 894-8(Aug. 1967).

Azimuth angles of shower particles produced in 24 and 27 GeV/c proton interactions were analyzed by two methods: the method of consecutive angles, (ii) the "minimum fall-out" method. It is concluded that azimuth angular distributions for stars with both $N_H < 4$ and $N_H > 4$ are consistent with isotropy and that spurious asymmetries can result from biased sampling. (auth)

46481 PROTON–DEUTERON ELASTIC SCATTERING AT HIGH MOMENTUM TRANSFERS. Coleman, Ernest. Ann Arbor, Mich., Univ. of Michigan, 1966. 117p.

Thesis.

An experimental and theoretical investigation of proton-deuteron elastic scattering at high momentum transfers is presented. The differential cross sections for backward elastic scattering at incident proton kinetic energies of 1.0, 1.3, and 1.5 GeV were measured for four-momentum transfer squared (−t) from 2.6 to 5.0 $(GeV/c)^2$, which corresponds to cosine of center-of-mass proton scattering angles ($\cos\theta^*$) from −0.5 to −0.9. A backward peak is observed, and the slope and magnitude of the peak were determined. At 2.0 GeV the forward elastic differential cross section was measured for −t from 0.44 to 1.54 $(GeV/c)^2$ or $\cos\theta^*$ from 0.875 to 0.565. A shoulderlike departure from the forward diffraction peak was observed. The one-nucleon exchange peripheral model was successful in interpreting the backward peak. Calculations based on modern three-body quantum mechanical formalisms for the three-nucleon system supporting a two-body bound state also suggest the one-nucleon exchange process as the dominant mechanism. The measured forward differential cross section was explained by the importance of double-scattering of the incident proton at higher momentum transfers. A negative value for the ratio of the real part to the imaginary part of the neutron-

proton elastic scattering amplitude at 2.0 GeV is shown to yield maximum agreement with the experimental data. (Disser. Abstr.)

Strong (Meson-Induced)

Refer also to abstracts 45418, 46461, 46469, 46475, 46479, and 46631.

46482 (COO-1195-99) CROSS SECTIONS FOR π^+, π^-, K^+, AND K^- MESONS ON COMPLEX NUCLEI. Hassenzahl, William Verne (Illinois Univ., Urbana. Dept. of Physics). Aug. 1967. Contract AT(11-1)-1195. 141p. Dep. CFSTI.

Thesis.

A measurement of the absorption and diffraction cross sections of 3.5-GeV/c π and K mesons on beryllium, carbon, aluminum, copper and lead was made. A set of circular scintillation counters measured transmission as a function of angle for each element. Cross sections were then calculated from the observed transmissions. Absorption and diffraction cross sections are given for 3.5 GeV/c π^+, π^-, K^+ and K^- on beryllium, carbon and aluminum, for π^+, π^- and K^+ for copper, and for π^+ and π^- on lead. The diffraction cross sections are found to be larger than the values predicted by optical model calculations. This is discussed in terms of the relative magnitudes of the real and imaginary parts of the nuclear potential. (auth)

46483 $\bar{\Lambda}$ PRODUCTION IN 7.3 GeV/c K^+p INTERACTIONS. Chien, Chih-yung; Dauber, P. M.; Mellema, D. Joel; Schreiner, P.; Slater, W. E.; Stork, D. H.; Ticho, H. K. (Univ. of California, Los Angeles). Phys. Lett., 25B: 426-9(Oct. 2, 1967).

Reactions involving $\bar{\Lambda}$ and $\bar{\Sigma}^0$ production are studied in 7.3 GeV/c K^+p interactions. Cross sections and angular distributions are given. (auth)

46484 PRODUCTION OF A $N^*_\alpha(1575)$ BARYON RESONANCE IN K^+p REACTIONS. Bassompierre, G. (CERN, Geneva); Goldschmidt-Clermont, Y.; Grant, A.; (and others). Phys. Lett., 25B: 440-3(Oct. 2, 1967).

In a study of K^+p interactions at 5 GeV/c, evidence is found for production of a baryon resonance with S = 0, I = $\frac{1}{2}$, mass 1575 ± 19 MeV, width 128 ± 20 MeV. The observed decay branching ratio makes it plausible to identify this baryon with the S_{11} resonance found previously at 1570 MeV in the phase shift analysis of πp scattering. (auth)

46485 $\bar{\Xi}$ PRODUCTION IN K^+p INTERACTIONS AT 9 GeV/c. Shen, B. C.; Firestone, A.; Goldhaber, G. (Univ. of California, Berkeley). Contract W-7405-eng-48. Phys. Lett., 25B: 443-5 (Oct. 2, 1967). (UCRL-17726).

Charged $\bar{\Xi}$ production was observed in K^+p interactions at 9 GeV/c with $\sigma \approx 5.3$ μb. Nothing observed indicates that these $\bar{\Xi}$ hyperons are decay products of an intermediate resonance. No event consistent with $\bar{\Omega}$ production was found. (auth)

46486 $\pi^-\pi^0$ ELASTIC SCATTERING DATA FROM $\pi^-p \rightarrow \pi^-\pi^0p$ REACTION AT 2.77 GeV/c APPLICATION OF THE CHEW-LOW EXTRAPOLATION METHOD. Baton, J. P.; Laurens, G.; Reignier, J. (CEN, Saclay, France). Phys. Lett., 25B: 419-22(Oct. 2, 1967).

A Chew and Low extrapolation based on a large number of events gives the $\pi^-\pi^0$ elastic cross section as a function of the dipion mass. Similarly the behavior of S_2 and P_1 waves is specified in the ρ^- region. (auth)

46487 EVIDENCE FOR K*(1250) RESONANCE PRODUCTION IN K^+p INTERACTIONS AT 9 GeV/c. Goldhaber, Gerson; Firestone, Alexander; Shen, Benjamin C. (Univ. of California, Berkeley). Phys. Rev. Lett., 19: 972-6(Oct. 23, 1967). (UCRL-17722).

Evidence for K*(1250) resonance production in K^+p interactions at 9 GeV/c is presented. It is observed that the large $K\pi\pi$ mass enhancement in the region 1.1 to 1.5 GeV probably consists of three resonances at the observed masses 1.25, 1.36, and 1.42 GeV above a broad background due primarily to diffraction dissociation. (auth)

46488 PROPERTIES OF THE f* MESON. Barnes, V. E. (Brookhaven National Lab., Upton, N. Y.); Dornan, P. J.; Kalbfleisch, G. R.; (and others). Phys. Rev. Lett., 19: 964-7(Oct. 23, 1967). (BNL-11735).

New information concerning the decay modes and spin and parity assignment of the meson (f*) found from an analysis of $K^- + p$ interactions at 4.6 and 5.0 GeV/c in a hydrogen bubble chamber is presented. A systematic search for all possible decay modes was carried out, and resulted in direct observation of the K^+K^- mode, a restrictive upper limit for the 2π decay mode, a revision of the K*K decay rate, a two-standard deviation indication of an $\eta^0\pi\pi$ decay mode, and an upper limit for $\eta^0\eta^0$ decay. The absence of a K_1K_2 mode establishes that the f* must be even under charge conjugation and restricts the possible J^P assignments to the values 0^+, 2^+, 4^+, etc. Studies of the KK decay angular distributions permit one essentially to rule out 0^+. (J.F.P.)

46489 THE REACTION $\pi^- + P \rightarrow \pi^+ + \pi^- +$ NEUTRON AT 8 BeV/c. Yuta, Haruo. Philadelphia, Univ. of Pennsylvania, 1966. 134p.

Thesis.

The BNL 80-inch liquid hydrogen bubble chamber was exposed to an 8 BeV/c π^- beam at the AGS. Approximately 100,000 pictures were taken, with about 14 tracks per picture. From 6000 two-prong events measured and analyzed, 1100 $\pi^-p \rightarrow \pi^-\pi^+n$ events were found. Search for high mass dipion resonances was the primary purpose in this experiment. No strong dipion resonance was observed beyond the f^0 meson. The absorptive model prediction agrees quite well with our data for the production and decay for the ρ^0. The f^0 is produced strongly but still with substantial background; the production and decay distributions agree less well with the theoretical prediction. The partial cross sections for the various two-prong reactions at 8 BeV/c are presented. The production cross section of the ρ^0 and f^0 ($\pi^+\pi^-$ channel) are obtained to be 0.24 ± (0.04) mb and 0.18 ± (0.04) mb, respectively. For the f^0 decay angular distribution, the non-resonant background makes a spin density matrix element ρ_{33} negative. The spin density matrix elements for the ρ^0 and f^0 are presented. (Disser. Abstr.)

46490 SOME TWO-BODY FINAL STATES OF K^-p INTERACTIONS AT 1.328 GeV/c. Trower, William Peter. Urbana, Ill., Univ. of Illinois, 1966. 127p.

Thesis.

A study was made of 21,187 two-prong, two-prong-kink and zero-prong-V events at an incident kaon momentum of 1.328 GeV/c using the Lawrence Radiation Laboratory's 72-inch hydrogen bubble chamber and the Scanning-Measuring Projector (SMP). The total and partial cross sections and where possible the production and polarization angular distributions of the final states were determined for the following interactions: $K^-p \rightarrow K^-p$, $K^-p \rightarrow K^0n$, $K^-p \rightarrow \Lambda\pi^0$, $K^-p \rightarrow \Sigma^+\pi^-$, and $K^-p \rightarrow \Sigma^-\pi^+$, $K^-p \rightarrow \Sigma^0\pi^0$, $K^-p \rightarrow K^+\Xi^-$, $K^-p \rightarrow \eta\Lambda$. The angular distributions are discussed in terms of known resonances. Diffraction model fits are made to the elastic scattering data. (Disser. Abstr.)

Particle Interactions and Properties (Theoretical)

Refer also to abstract 46041.

General

46491 (COO-1371-43) THEORETICAL PHYSICS PROGRAM. Progress Report, September 1, 1966-August 31, 1967. (Minnesota Univ., Minneapolis. School of Physics). Sept. 1967. Contract AT(11-1)-1371. 38p. Dep. CFSTI.

Theoretical and experimental investigations in high-energy and nuclear physics are briefly described. A list of papers published and soon to be published is also included. (J.F.P.)

46492 (INR-824/VI/PH) KWANTOWA GEOMETRIA FAZOWA. (Quantum Phase Geometry). Chylinski, Z. (Institute of Nuclear Research, Warsaw (Poland)). 1967. 56p. (In Polish). Dep.

A new geometrical framework is proposed called the phase geometry. It provides us with a parametrization of the internal degrees of freedom of isolated systems which results in the modification of interaction of high-energy particles. (auth)

46493 (NYO-3399-125) ALGEBRAIC METHOD AND INFINITE COMPONENT WAVE EQUATIONS. Bohm, A. (Syracuse Univ., N. Y. Dept. of Physics). Aug. 1967. Contract AT(30-1)-3399. 49p. (SU-1206-125). Dep. CFSTI.

The infinite component wave equation approach is presented in a way which exhibits its relation to the algebraic method. The Majorana case is described in full detail and an algebraic reformulation of it is given. The Nambu and Fronsdal equations are considered. (auth)

46494 THE SU(3) STRUCTURE OF THE $\frac{3}{2}^-$ BARYONS. Hendry, Archibald W. (Univ., Heidelberg). Z. Phys., 206: 345-54(1967).

The SU(3) structure of the $\frac{3}{2}^-$ baryons N*(1525), Ξ*(1820), $Y_1^*(1660)$, $Y_1^*(1715)$, $Y_0^*(1520)$ and $Y_0^*(1700)$ is investigated on the hypothesis that they form a decuplet-octet-singlet combination. Their branching ratios seem to be consistent with this picture.

Mixing angles are determined, and $\Xi^*(1820)$ is deduced to be mainly decuplet. (auth)

46495 HELICITY PROJECTION OPERATORS FOR SPIN 3/2 PARTICLES. Sarkar, S. (Indian Association for the Cultivation of Science, Calcutta). Proc. Phys. Soc. (London), 91: 577-80(July 1967).

The projection operators for different helicity states of spin 3/2 particles are calculated. (auth)

46496 CONSISTENCY OF CURRENT COMMUTATORS. Goldberg, Irwin (Aerospace Research Labs., Wright-Patterson AFB, Ohio); Marx, Egon. Nucl. Phys., B3: 25-32(1967).

An apparent paradox that originates from current commutators, followed by its solution is presented. The origin of this and related difficulties is the ambiguity in the definition of products of generalized functions. It is concluded that there is no need to modify the current commutators. (auth)

46497 INFINITE-COMPONENT WAVE EQUATION WITH RELATIVISTIC ROTATOR MASS SPECTRUM. Takabayasi, Takehiko (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto), 38: 285-7(July 1967).

It is considered that elementary particle states are related to an essentially relativistic internal movement of a supposedly composite structure. For exemplifying this approach it is useful to start from the proposition of the existence of an underlying unified wave equation of particles. When quantized such a wave equation represents a relativistic field theory of structured particles. A new relativistic wave equation is set forth which describes different mass–spin in such a way that it associated a reasonable spin dependence of the mass. The resulting mass formula is found to differ from previous formulas, but just corresponds to the inverted Majorana mass formula. (J.F.P.)

46498 ORDERING OF ENERGY LEVELS IN MANY PARTICLE SYSTEMS. Smigielski, Z. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys., 15: 415-19(1967).

A quark model for baryons with essential three-body interaction forces was previously proposed. The ordering of the lowest baryonic energy levels within this model is obtained. Some general properties of the eigenfunctions of a given quantum mechanical system are also discussed. (J.F.P.)

46499 A THEORY OF ANOMALOUS GRAVITATIONAL INTERACTION. II. CASE OF THE DIRAC PARTICLE. Kimura, Toshiei; Senba, Kei (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto), 38: 261-81(July 1967).

Starting from the most general gravitational form factors of the Dirac particle in Minkowski space, a generally covariant Lagrangian is found for the most general gravitational interaction which does not necessarily satisfy C, P, and T symmetries separately. The Lagrangian is expressed in terms of the generalized γ^μ matrix and the spin connection. It is shown that one may obtain a consistent gravitational theory by taking both the γ^μ matrix and the spin connection as independent field variables. Also, the gravitational form factors are derived in a generally covariant form as a result of the radiative corrections due to the interactions between the Dirac particle and other Bose particles. The discontinuous transformation in the curved space is also touched in brief. (auth)

46500 YADERNYE VZAIMODEISTVIYA PRI VYSOKIKH ENERGIYAKH. (High-Energy Nuclear Reactions). Tbilisi, USSR, Metsniereba Publishing House, 1966. 132p.

The book included eight chapters. Separate abstracts were prepared for each chapter. (J.F.P.)

For abstracts of individual chapters see: 45404, 45405, 46458, 46501, 46509, 46568, 46592, and 46593.

46501 ANALYSIS OF EXPERIMENTAL DATA SATISFYING A DISTRIBUTION OF THE TYPE $x^m dx$. Roinishvili, N. N.; Mandritskaya, K. V. pp 80-95 of Yadernye Vzaimodeistviya pri Vysokikh Energiyakh. Tbilisi, USSR, Metsniereba Publishing House, 1966. (In Russian).

Estimation of the value of m in the distribution $x^m dx$ by the maximum probability method is analyzed and the most powerful criterion for analysis of a distribution of that type is proposed. The probabilities of the two errors dangerous in checking the statistical validity of the hypothesis f(x)dx (rejecting f(x)dx when it is valid and accepting it when g(x) dx is valid) are determined. It is shown that use of the criterion X^2 with the Bayes method does not permit determining the probability of error of the second type, and numerous other reasons for not using that criterion are given. (JPRS)

46502 PROCEEDINGS OF THE 1966 MIDWEST CONFERENCE ON THEORETICAL PHYSICS, INDIANA UNIVERSITY, MAY 20–21, 1966. Lichtenberg, D. B. (ed.). Bloomington, Ind., Indiana University, 1966. 182p. (CONF-660545).

The conference included 12 papers two of which were abstracted previously in NSA. For abstracts of these papers see NSA 20: 42328 and 21: 2504. Separate abstracts were prepared for nine papers. Another paper not abstracted described statistical mechanics applied to molecules. (J.F.P.)

For abstracts of individual papers see: 46132, 46403, 46503, 46504, 46508, 46539, 46559, 46798, and 46799.

46503 CURRENT ALGEBRAS. Treiman, S. B. (Princeton Univ., N. J.). pp 143-9 of Proceedings of the 1966 Midwest Conference on Theoretical Physics, Indiana University, May 20–21, 1966. Lichtenberg, D. B. (ed.). Bloomington, Ind., Indiana University, 1966.

See CONF-660545.

A general idea of the applications and ideas of current algebra is presented rather than a systematic review. Some elementary particle interactions and decays are discussed in this review. (J.F.P.)

46504 APPLICATIONS OF CURRENT COMMUTATION RELATIONS. Haag, R. (Univ. of Illinois, Urbana). pp 150-6 of Proceedings of the 1966 Midwest Conference on Theoretical Physics, Indiana University, May 20–21, 1966. Lichtenberg, D. B. (ed.). Bloomington, Ind., Indiana University, 1966.

See CONF-660545.

Axiomatic field theory as well as current commutators and their applications is discussed. It is found that the applications of the current algebra scheme stem from the ideas that the Green functions of the currents contain information about both hadronic and weak or electromagnetic processes, and that the kinematical relations give additional theoretical information about the Green functions of the currents. (J.F.P.)

Electromagnetic

Refer also to abstract 46548.

46505 (NEVIS-163) NONORTHOGONALITY OF THE LONG- AND SHORT-LIVED NEUTRAL KAON STATES AND PHENOMENOLOGICAL ANALYSIS OF EXPERIMENTS ON CP VIOLATION IN K^0 DECAY. Bennett, Sheldon, Nygren, David; Saal, Harry; Steinberger, Jack; Sunderland, John (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Labs.). 1967. Contract AT(30-1)-1932. 10p. (CU-1932-267). Dep. CFSTI.

It is noted that the nonzero charge asymmetry in the $K_{L_{e3}}$ decay demonstrates the nonorthogonality of the K_L^0 and K_S^0 states. The result of previous work on the charge asymmetry is then combined with other measurements relevant to CP violation in K decay. It is found that the experimental results are consistent with a phenomenological analysis. The pion–pion scattering phase shift which follows from this analysis is consistent with other indirect observations only if the mass difference $m_L - m_S$ is negative. (auth)

46506 PION-EXCHANGE CONTRIBUTIONS TO THE LOW-ENERGY PHOTODISINTEGRATION OF DEUTERONS. Reitan, Arne; Myhrer, Fred (Norges Tekniske Hoegskole, Trondheim, Norway). Nucl. Phys., B3: 130-8(1967).

The E1 total cross section for photodisintegration of the deuteron is calculated for photon energies up to 160 MeV by taking into account the contributions from some pion-exchange diagrams. These are found to have a pronounced influence on the results even at low energies. (auth)

46507 ANALYTIC CONTINUATION OF NUCLEON FORM FACTORS. Bowcock, J. E.; Cottingham, W. N.; Williams, J. G. (Birmingham Univ., Eng.). Nucl. Phys., B3: 95-105(1967).

A new inversion formula for the Stieltje's transform is derived and used for the analytic continuation of nucleon form factors. For given experimental accuracy the extent to which the spectral functions may be determined is analyzed and with present data it is clear that only a very poor resolution may be obtained. An estimate of the experimental accuracy required to resolve the rho contribution is given. (auth)

46508 DIFFRACTION DISSOCIATION. Ross, M. H. (Univ. of Michigan, Ann Arbor). pp 118-28 of Proceedings of the 1966 Midwest Conference on Theoretical Physics, Indiana University, May 20–21, 1966. Lichtenberg, D. B. (ed.). Bloomington, Ind., Indiana University, 1966.

See CONF-660545.

Some of the properties of the exchange processes in diffraction dissociation are calculated using simple models. Photoproduction of mesons (ρ) on hydrogen is considered. (J.F.P.)

46509 CASCADE THEORY OF SHOWERS. Gedalin, E. V. pp 4-45 of Yadernye Vzaimodeistviya pri Vysokikh Energiyakh. Tbilisi, USSR, Metsniereba Publishing House, 1966. (In Russian).

The cascade theory of showers is examined in detail, using the method of first impact to derive the fundamental equations of the theory, upon the assumption that each particle participating in the development of a shower generates a cascade independently of the others; this means that the stochastic process of development of a cascade is a Markovian process. Equations derived for one dimension are generalized for the three-dimensional picture, and fluctuations of the spatial distribution of particles in electron-photon showers are calculated. (JPRS)

46510 TESTS OF THE $|\Delta T| \leq 1$ RULE IN VARIOUS PROCESSES OF COLLISION CHAINS e^+e^-. Benayoun, M. (College de France, Paris). Nuovo Cim.(10), 51A: 832-6(Oct. 1, 1967). (In French).

In order to obtain experimental predictions on electromagnetic form factors of baryons and resonances, which constitute tests of $|\Delta T| \leq 1$, a general definition of iso-spinors for any isotopic spin, and the notion of "Selector of processes" are introduced, the use of which is to single out a given reaction by its isotopic-spin component. The application to certain electromagnetic vertices allows one to obtain tests of $|\Delta T| \leq 1$. (auth)

46511 ON THE $\eta \rightarrow \gamma\gamma$ DECAY MODE AND THE VECTOR-MESON DOMINANT MODEL. Baracca, A. (Univ., Bologna); Bramon, A. Nuovo Cim. (10), 51A: 873-7(Oct. 1, 1967).

It is shown that the vector-meson-dominant model introduced by Gell-Mann, Sharp, and Wagner can justify the large width found in recent experiments for the $\eta \rightarrow \gamma\gamma$ decay. The decays $\pi^0 \rightarrow \gamma\gamma$, $\eta \rightarrow \gamma\gamma$, and $\eta \rightarrow \pi^+\pi^-\gamma$ are calculated by assuming two-step processes. The decay modes of the X^0 involving photons include those previously considered in the decay on the η-meson, namely 2γ, $\pi\pi\gamma$, and in addition $\rho^0\gamma$. The rates for these processes are calculated by the same methods. Finally, the consistency of the pole model in connecting the π^0 lifetime and the width of the $\omega \rightarrow \pi^0\gamma$ transition is shown. (L.B.S.)

46512 PHENOMENOLOGICAL STUDY OF THE PHOTODISINTEGRATION OF THE DEUTERON BY POLARIZED PHOTONS. Papageorgiou, S.; Verganelakis, A. (Democritus Nuclear Research Center, Athens). Nuovo Cim. (10), 51A: 820-31(Oct. 1, 1967).

From the recently measured asymmetry Σ for the photodisintegration of the deuteron and employing the existing experimental data on the differential cross section with unpolarized γ-rays, the quantities $(d\sigma/d\Omega)_{||}$ and $(d\sigma/d\Omega)_{\perp}$ were calculated in the energy region (80 to 400) MeV. The results show a bump for $(d\sigma/d\Omega)_{\perp}$ at about 250 MeV incident-photon energy, while the available experimental data are not sufficient to make clear whether the behavior of $(d\sigma/d\Omega)_{||}$ is similar to that of $(d\sigma/d\Omega)_{\perp}$. A comparison of various theoretical approximations with the values of Σ, $(d\sigma/d\Omega)_{\perp}$ and $(d\sigma/d\Omega)_{||}$ is carried out. It is shown that none of these approximations based only on the direct radiative interaction predicts the behavior of Σ, $(d\sigma/d\Omega)_{\perp}$ and $(d\sigma/d\Omega)_{||}$. The observed discrepancy is attributed to the unreliability of the calculation of the magnetic-dipole amplitudes based on the direct radiative interaction. Evidence for the significance of the meson-effect contributions to the quantities Σ, $(d\sigma/d\Omega)_{||}$ and $(d\sigma/d\Omega)_{\perp}$ was obtained. An estimate of the nucleon isobar contribution to the quantities Σ, $(d\sigma/d\Omega)_{||}$ and $(d\sigma/d\Omega)_{\perp}$ superimposed on an electric-dipole background is carried out. (auth)

46513 CLASS OF NONINTEGRABLE SINGULAR ELECTROMAGNETIC FIELDS. Zund, J. D.; Levine, J. (North Carolina State Univ., Raleigh). Nuovo Cim. (10), 51A: 687-95(Oct. 1, 1967).

The source-free Maxwell equations are solved in a conformally flat space-time to give a class of nonintegrable singular electromagnetic fields. These solutions have the property that the associated electromagnetic waves do not possess wave-fronts. The properties of these solutions are investigated and a physical interpretation is proposed. (auth)

46514 ON THE THEORY OF PHOTO- AND ELECTROPRODUCTION OF THE N(1236). Gutbrod, F.; Simon, D. (DESY, Hamburg). Nuovo Cim. (10), 51A: 602-23(Oct. 1, 1967).

Multipole dispersion relations and the Fredholm determinantal method are applied to the calculation of the transverse part of the γNN^* vertex, using relativistic kinematics. The unphysical cuts of the multipole amplitudes have been approximated by the second-order and fourth-order (box) diagrams containing nucleon and pion exchange. No cut-off is necessary. The results for the magnetic-dipole amplitude agree, within the theoretical errors, with those of the static theory, while the electric quadrupole turns out to be resonant too. The behavior of the transition amplitudes for large momentum transfer is discussed. (auth)

46515 FORWARD COMPTON SCATTERING AT HIGH ENERGY AND THE DRELL–HEARN–GERASIMOV SUM RULE. Dombey, Norman (Harvard Univ., Cambridge, Mass.). Phys. Rev. Lett., 19: 985-7(Oct. 23, 1967).

It is pointed out that instead of testing the sum rule for the absorption of photons by protons directly, it is possible to test the assumptions on which it is based using measurements involving only unpolarized photons and protons. (J.F.P.)

46516 PION-EXCHANGE CONTRIBUTIONS TO THE LOW-ENERGY PHOTODISINTEGRATION OF DEUTERONS. Reitan, Arne; Myhrer, Fred. (Norges Tekniske Hoegskole, Trondheim, Norway). Ark. Fys. Seminar Trondheim, No. 8, 18p.(1967).

The E1 total cross section for photodisintegration of the deuteron is calculated for photon energies up to 160 MeV by taking into account the contributions from some pion-exchange diagrams. These are found to have a pronounced influence on the results even at low energies. (auth)

46517 ELECTROMAGNETIC FORM FACTOR OF THE MEDIUM IN SCATTERING, BREMSSTRAHLUNG, AND PAIR PRODUCTION PROCESSES. Batygin, V. V. (Leningrad Polytechnic Inst.). Zh. Eksp. Teor. Fiz., 53: 890-902(Sept. 1967). (In Russian).

The multiparticle approach to the scattering of charged particles is extended to bremsstrahlung and pair production. The probabilities for all three electromagnetic processes can be expressed in terms of the same electromagnetic form factor of the medium and it is this fact which underlies the parallelism of the three processes. The properties of the medium form factor are considered and the relation of the factor to the dielectric constant of the substance is elucidated. It is noted that such bremsstrahlung and pair production processes may exist in which the excess energy and momentum are transferred to various collective excitations of the medium; the usual case when the excess energy and momentum are transferred to separate atoms of the medium or to the lattice as a whole is one of the possibilities. Corrections to the bremsstrahlung and positron spectra are obtained which take into account multiparticle effects; the magnitude of the corrections may reach 10% for small Z. Multiparticle effects may be very pronounced if the region of small values of transferred momenta, which is important for them, is separated out by the coincidence technique. It is pointed out that bremsstrahlung and pair production in a narrow channel in matter may exist when the usual transfer mechanism is invalid. (auth)

46518 THE DECAY $\eta \rightarrow \pi^0\gamma e^+e^-$. Jarlskog, C.; Pilkuhn, H. (Univ. of Lund, Sweden). Nucl. Phys., B3: 73-6(1967).

The branching ratios $\Gamma(\eta \rightarrow \pi^0\gamma e^+e^-)/\Gamma(\eta \rightarrow \pi^0\gamma\gamma)$ and $\Gamma(\eta \rightarrow \pi^0e^+e^-e^+e^-)/\Gamma(\eta \rightarrow \pi^0\gamma\gamma)$ are calculated using ordinary quantum electrodynamics. (auth)

46519 STRUCTURE AND EXCITATION MECHANISM OF THE N^* IN ELECTROPRODUCTION $e + p \rightarrow e + N^*$. Fujimura, Kimio; Kobayashi, Tsunehiro; Kobayashi, Tetsuro; Namiki, Mikio (Waseda Univ., Tokyo). Progr. Theor. Phys. (Kyoto), 38: 210-25 (July 1967).

The electroproduction of the nucleon resonance $ep \rightarrow eN^*$ is theoretically investigated on the basis of the composite particle model of hadrons, in which the hadron is in a bound state of fundamental constituent particles forming a triplet. The working hypotheses or assumptions used for the structure of the nucleon, and its resonances and for the electromagnetic interaction are the same as those made previously on the photoproduction $\gamma p \rightarrow N^*$. The nucleon and its resonances concerned are described by the $\{56\}$-representation of the SU_6. In particular, the N and the N^*_{33} belong to the lowest $\{56\}$-representation with the S-wave inner space wave function, while other resonances are in the one-particle excitation mode. The electroproduction is assumed to be caused through the electromagnetic interaction without the exchange current among fundamental constituent particles. The selection rules are the same as those of the photoproduction, except for the Coulomb excitation. Owing to the virtuality of photon exchanged between e and p, it is expected to get more significant information from the electroproduction rather than those obtained from the photoproduction. For this reason the q^2-dependences of the differential cross section $(d^2\sigma/d\Omega'd\epsilon')$, the ratio of the magnetic multipole transition to the electric one and the ratio of the Coulomb excitation to the transverse one are calculated, q being the momentum transfer conveyed by the virtual photon. The model includes two parameters representing the linear extension of the nucleon and the boson cloud effect. By adjusting them to plausible values, it is shown that the theoretical re-

sults for the above quantities are consistent with the existing experiments, although experimental data are still scarce. The characteristic feature of the theoretical results is the appearance of the zero point in $(d^2\sigma/d\Omega' d\epsilon')$ vs q^2 for the $N^*(I = 3/2)$. Their positions are to be easily covered by working machines, even though the existing experiments have not covered them yet. Finally remarks are made on a possible way of determining the absolute value of the magnetic moment of the fundamental particle, and on the effect of the presence of the N*(1688) on the observed cross section. (auth)

46520 PHOTOPRODUCTION OF NEUTRAL PIONS FROM THE NUCLEON AND THE DEUTERON IN THE REGION OF THE FIRST AND SECOND RESONANCES. Yamaki, Tetsuji (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto), 38: 153-71(July 1967).

Cross sections for the neutral pion photoproduction from protons and neutrons are calculated with the CGLN amplitudes and the phenomenological amplitudes of the s_{11}^-, s_{31}^-, p_{33}^-, p_{11}^- and d_{13}^-waves at photon energies from 300 to 850 MeV. The angular distributions of the $\gamma + p \rightarrow \pi^0 + p$ reaction around the second resonance are explained under the assumption that the ratio of the amplitudes for the electric dipole and magnetic quadrupole transitions into the final d_{13}-state, E_{2-} and M_{2-}, is about 3 to 1. Cross sections for the coherent photoproduction of neutral pions from the deuteron are also calculated on the basis of the impulse approximation around the second resonance. The numerical results are compared with the experimental data. (auth)

46521 ELECTRIC DIPOLE MOMENT OF THE NEUTRON. Fitch, Val L. Comments Nucl. Particle Phys., 1: 151-4(Sept.-Oct. 1967).

Theoretical estimates and experimental results for the neutron electric dipole moment are summarized. A brief review is given of experiments based on CP violation in K^0 decay, neutron magnetic resonance, and neutron scattering by nuclear electric fields. Comments are made on new results and the origin of CP violation. (L.B.S.)

46522 NUCLEON ISOSCALAR FORM FACTOR. Campbell, Fumiyo Uchiyama. San Diego, Calif., Univ. of California, 1965. 100p.

Thesis.

The isoscalar charge and magnetic moment form factors of the nucleon are calculated assuming that the low-energy part of the spectral functions are determined by the three-pion and $K\bar{K}$ intermediate states. The spectral functions are calculated using the unitarity condition which reduces the problem to finding the $N\bar{N}-K\bar{K}$ and $N\bar{N}-3$ pi (in our case $\pi\rho$) amplitudes and the $\gamma-K\bar{K}$ and $\gamma-\pi\rho$ vertex function. Two cut-off constants appear in the calculation of the $N\bar{N}-\pi\rho$ and $N\bar{N}-K\bar{K}$ amplitudes. Some results which are independent of the arbitrariness arising from these cut-offs are found, namely the $K\bar{K}$ intermediate state gives a negative derivative to the charge and magnetic moment form factors and the minimum contribution from $K\bar{K}$ to the form factors, within the approximation taken, is found. The results are compared with experimental analyses of the isoscalar form factors G_E and G_M as well as the charge and magnetic moment of the proton. Contrary to the common expectation, the $K\bar{K}$ resonance, Φ, rather than the 3 pi resonance, ω, seems to provide the dominant contribution to the charge and magnetic form factors under the assumption that the nucleon pole in the $N\bar{N}-\pi\rho$ scattering amplitude and Λ and Σ pole in the $N\bar{N}-K\bar{K}$ scattering amplitude furnish the dominant unphysical cuts. (Disser. Abstr.)

Weak

Refer also to abstract 46530.

46523 (SLAC-PUB-338) CURRENT ALGEBRA AT SMALL DISTANCES. Bjorken, J. (Stanford Linear Accelerator Center, Calif.). Aug. 1967. Contract AT(04-3)-515. 45p. Dep. CFSTI.

A discussion of the effects of the application of the same current algebra for local current densities in quantum electrodynamics as for the charges is given. The kinematics of lepton scattering processes is discussed, and a sum rule is derived for neutrino processes, and from it a corollary for electron-scattering processes. An interpretation in terms of elementary constituents of the nucleon is suggested. Using this interpretation more predictions for inelastic lepton scattering are made, and these are compared with experimental data. Finally, the radiative corrections to the Fermi part of beta decay are discussed, and it is argued on the basis of the local algebra that these corrections diverge logarithmically, just as for point charges. (J.F.P.)

46524 STRONG SYMMETRIES AND WEAK CURRENTS. Low, Francis E. Comments Nucl. Particle Phys., 1: 164-8(Sept.-Oct. 1967).

A discussion is given on quantities that are exactly or approximately conserved in strong interactions, and the existence of currents corresponding to these quantities. The connection between leptonic decay of hadrons and hadronic current is discussed. In addition to the accurate conservation of isotopic spin, two other cases are pointed out: the extension of SU(2) to SU(3), and the approximate chiral symmetry of strong interactions. (L.B.S.)

46525 PSEUDO-LOCALITY OF SPACE-TIME AND LEPTONS. Shinohara, Yasutada (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto), 38: 282-3(July 1967).

It is proposed that four leptons, e, μ, ν_e, and ν_μ, are the four independent internal states of a single entity lepton which constitutes the spinor representation not only of the usual Lorentz group but of this internal Lorentz group also. Therefore the lepton field operator is now represented by a 4×4 component spinor. To classify the internal states of the lepton use is made of the internal Pauli matrices and the internal Dirac matrices. The internal chirality and the third component of the internal spin are listed for the leptons studied. It is suggested that the symmetry breaking electromagnetic field might be ascribed to the large-scale nonflat metrical structure of space-time which inevitably affects the congruent group of the pseudo-local points. (J.F.P.)

46526 NEUTRINO ABSORPTION IN ^2H AND ^{12}C. Kelly, Francis Joseph. Washington, D. C., Catholic Univ. of America, 1966. 128p.

Thesis.

The purpose of this study is to obtain theoretical cross sections for neutrino reactions in deuterium and ^{12}C. The deuterium reaction is important for a determination of solar neutrino fluxes (experiment at Case Institute). The ^{12}C reaction can be used for experimentally obtaining the neutrino spectrum from accelerators (Brookhaven and CERN experiments). For the deuterium reaction only low-energy electron neutrinos are considered and the dipole approximation is used because of the low momentum transfer. A ^3S exponential function is used to describe the deuteron wave function and a ^1S combination of regular and irregular Coulomb wave functions for the proton-proton wave function. The matrix element is approximated in the nuclear force region by an expression involving the effective ranges. The total cross section was found to be ~20% lower than the corresponding antineutrino reaction for the same energy above threshold. For Bahcall's values of solar neutrino fluxes at the earth, the counting rate is 2.3×10^{-35} events $sec.^{-1}$ $nucleus^{-1}$. For the ^{12}C reaction high energy muon and electron neutrinos and antineutrinos are considered. After the neutrino reaction the nucleus is left in a giant dipole resonance state, which is described by the Brown one-particle one-hole model. The giant dipole states are constructed from a superposition of single-particle-shell model states. The coefficients of Lewis and Walecka and deForest and of Gillet are used, and the differential and total cross sections for exciting each state are calculated. Also the $^{12}N_{gi.dip.} \rightarrow {}^{11}C + p$ proton spectrum is calculated becasue this decay can identify the neutrino reaction mechanism in a bubble chamber. The total cross sections calculated from the LWD and Gillet coefficients agree very well with one another for all neutrino energies, and they agree with Überall's values within ~30% above 300 MeV. The total cross sections remain approximately constant at 1.5×10^{-41} cm^2 above 500 MeV. To check the programs, deForest's muon capture matrix elements are calculated, and it is found that some of his published values are in error because a factor $(-1)^{l'}$ was omitted. (Disser. Abstr.)

Strong (General)

46527 DIVERGENT SUM RULES AND UNIVERSALITY OF SHORT-RANGE REPULSION. Serebryakov, V. V.; Shirkov, D. V. (Inst. for Mathematics, Novosibirsk, USSR). Nuovo Cim. (10), 51A: 878-81(Oct. 1, 1967).

A new method using the semi-phenomenological short-range repulsion and a coupling γ of the order of one Compton pion wavelength was previously proposed and developed for low-energy $\pi\pi$ and πN scattering. The coupling constants were expressed by the integrals of the imaginary parts of the crossing-even forward scattering amplitudes. Using asymptotic relations between the amplitudes (and total cross sections) based on the quark additivity hypothesis, relations are obtained between the parameters γ for different processes, as well as new sum rules which involve symmetrical amplitudes for different processes nonvanishing at infinity. (L.B.S.)

46528 HUNTING OF THE QUARK. Lederman, Leon. Comments Nucl. Particle Phys., 1: 155-9(Sept.-Oct. 1967).

Brief comments are made of the current status of the search for quarks. Some recent results from cosmic-ray and accelerator experiments are tabulated. (L.B.S.)

46529 RESONANCES AND ANTISHRINKAGE OF DIFFRACTION PEAK. Hasebe, Katsuya (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto), 38: 202-9(July 1967).

An attempt is made to account for the energy dependence of the slope (shrinkage or antishrinkage) of differential cross section in p-p and p-$\bar{p}$ diffraction scattering. It is assumed that the effective interaction is described by a potential around the black sphere and that the potential is repulsive or attractive for the p-p or the p-$\bar{p}$ system, respectively. $\pi^{\pm}$-p and $K^{\pm}$-p scattering are also discussed in connection with resonances. (auth)

Strong (Baryon No. = 0)

Refer also to abstracts 46486 and 46539.

46530 (UR-875-214) NEW APPROACH TO ALGEBRA OF CURRENT AND WEINBERG SUM RULES. Okubo, Susumu (Rochester Univ., N. Y. Dept. of Physics and Astronomy). Aug. 22, 1967. Contract AT(30-1)-875. 19p. (CONF-670824-1). Dep. CFSTI.

From International Theoretical Physics Conference on Particles and Fields, Rochester, N. Y.

Two rather separate subjects of the algebra of currents are discussed. The first one is a proposal to use the algebra of currents only for determining subtraction constants in once-subtracted dispersion theory of two-body decay modes such as $K \to 2\pi$, $\Lambda \to N\pi$, or $\rho \to 2\pi$. In this way, hitherto neglected corrections are computed. Also, in the technique, allowing $k \to 0$ directly is avoided (k being the four-momentum of the pion) but rather $k^2 \to 0$ is allowed. Hence, for example, in $K \to 2\pi$ decay one does not have the troublesome neglect of the kaon-pion mass difference which results as a consequence of the energy-momentum conservation in the ordinary method. The second topic is mainly devoted to a generalization of Weinberg sum rules, taking account of SU(3)-violating interactions at high energy. In this way the decay rates of $\omega \to 1\Gamma$, $\phi \to 11$, $K^* \to K\pi$, and $\phi \to K\bar{K}$ were computed, and they are compared with experiment. Also ordinary SU(3) mass formulas were rederived from this new viewpoint. (auth)

46531 ON THE EFFECT OF THE U(3)-INVARIANT INTERACTIONS IN A BOUND SYSTEM. Maekawa, T. (Kumamoto Univ., Japan). Nucl. Phys., B3: 115-29(1967).

In order to see the effect of the U(3)-invariant interactions H_1 and H_8 in a composite system, the two-body system of a particle and an antiparticle is examined numerically in the case of the vector four-fermion interaction. The following results are obtained. For spin singlet states, the ratio G_8/G_1 of the coupling constants of H_1 and H_8 is equal to -2 and δm is 400 MeV. On the other hand, for spin triplet states the coupling constant G_8 of H_8 is desirable to be zero and δm is equal to 170 MeV. (auth)

46532 SUPERCONVERGENCE RELATIONS FOR AXIAL-VECTOR PSEUDOSCALAR MESON SCATTERING. Rivers, R. J. (Imperial Coll. of Science and Tech., London). Nuovo Cim. (10), 51A: 728-35(Oct. 1, 1967).

The effect of the predictions of the superconvergence sum rules for axial-vector pseudoscalar meson scattering on axial-vector meson decays into one vector and one pseudoscalar meson is considered. Assuming SU_3 invariance it is shown that these rules imply s-wave decay phase space for both axial-vector nonets known experimentally to exist. For those processes where the vector meson decays into two pseudoscalar mesons an s-wave angular correlation is implied. These predictions are compared with the higher symmetry group predictions and with indirect theoretical estimates for angular correletions. (auth)

46533 $\bar{N}N$ ANNIHILATION INTO TWO PSEUDOSCALAR MESONS AT HIGH ENERGY. Barger, V.; Cline, D. (Univ. of Wisconsin, Madison). Contract AT(11-1)-881. Phys. Lett., 25B: 415-18(Oct. 2, 1967). (COO-881-114).

The amplitudes for the $\bar{N}N \to \bar{M}M$ annihilation channel are related to the amplitudes for backward MN elastic scattering using a Reggeized baryon exchange model. The angular distributions for $\bar{N}N \to \bar{\pi}\pi$ at high energy are qualitatively predicted from data on πN elastic scattering at large angles. Several cross section relations are obtained for the $\bar{N}N \to \bar{K}K$ reactions that should be subjected to experiment test. (auth)

46534 PARTIAL CONSERVATION AND THE 2^+ MESONS. Krolikowski, W. (Univ., Warsaw. Inst. for Nuclear Research, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys., 15: 407-9(1967).

The 2^+ mesons, which have stress tensors as sources, are discussed assuming the hypothesis that the stress tensor $\theta_{\mu\nu}(x)$ (being a symmetrical, conserved but not traceless tensor) is proportional to a superposition of the neutral 2^+ mesons f(1254) and a neutral 0^+ meson called σ. This hypothesis may also be considered a partial conservation relation since the stress tensor $\theta_{\mu\nu}$ can be identically expressed as the divergence of a tensor of the third rank. (J.F.P.)

Strong (Baryon No. = 1)

Refer also to abstracts 46530, 46533, and 46549.

46535 (ANL-Trans-497) MECHANISM OF TWO BODY INTERACTION AT HIGH ENERGIES. Sonderegger, P. Translated by William Sluis (Argonne National Lab., Ill.), from J. Phys. (Paris), Colloq., 27: C4-11-C4-22(1966). 25p. Dep. CFSTI. JCL $2.60 fs, $0.98 mf.

The discovery of quasi-elastic processes of the diffractive type with a region of momentum that is independent of the energy, and the clarification of the mechanism of the exchange process produced by experimental confirmations of the Regge pole model are considered. The importance that is attached to the rate of dependence on energy of the momentum regions, integrated as well as differential, in the transfer of fixed pulsing is emphasized. (J.F.P.)

46536 N/D APPROACH TO πN SCATTERING IN THE P_{11} STATE WITH SHORT-RANGE FORCES. Kaschluhn, F. (Humboldt-Univ., Berlin. Deutsche Akademie der Wissenschaften, Berlin). Nucl. Phys., B3: 139-46(1967).

The πN scattering in the P_{11} state is treated in a one-channel N/D approach in elastic approximation. It is shown that the compositeness condition $\delta_{11}(\infty) = -\pi$ for the nucleon and the zero of $\delta_{11}(\omega)$ in the low-energy region can be made consistent with each other by taking into account short-range forces appropriately. For a given nucleon-pole position and given contributions from N,N^* and ρ exchange, the required value for the πN coupling constant and two zeros of $\delta(\omega)$ for physical ω are found, one of them in the low-energy region at the right position. The parameters of the short-range forces approximated by a pole term are fixed by asymptotic conditions on the behavior of the scattering amplitude at large energies. (auth)

46537 A SUM RULE CONNECTING THE $\frac{1}{2}^+$ AND $\frac{1}{2}^-$ BARYON SPECTRA. Rothleitner, J. (Univ., Heidelberg). Nucl. Phys., B3: 89-94(1967).

A local commutation relation between the axial vector currents and the baryon spinor field is postulated. From this a sum rule is derived which connects the $J^P = \frac{1}{2}^+$ and $J^P = \frac{1}{2}^-$ baryon spectral functions. This sum rule indicates an approximate parity doublet structure in the baryon spectrum. An evaluation of the sum rule for the nucleons is given under the assumptions that the four experimentally known nucleons saturate it and that they also saturate the nucleon vertex functions. A possible form of the result is the prediction $g^2_{N\sigma}/\sqrt{4\pi} \approx 1.15$. (auth)

46538 ANALYSIS OF THE K-p CHARGE EXCHANGE AT HIGH ENERGY BY MEANS OF TWO REGGE POLES ρ AND R. Derem, A. (CEN, Saclay, France). Nucl. Phys., B3: 106-14 (1967). (In French).

A test is proposed on the differential cross sections for the reaction $K^- + p \to \bar{K}^0 + n$ at high energy. This test does not rely on any assumption about the form of the residue functions. If the reaction is to be described by two Regge poles, the ρ and R poles, then there is a quantity $\Sigma(w_L,t)$ which must become independent of the energy at the point where $\alpha_\rho(t) = \alpha_R(t)$. The experimental results are compatible with the Regge hypothesis. (auth)

46539 BARYONIC RESONANCES. Dalitz, R. H. (Oxford Univ.). pp 94-117 of Proceedings of the 1966 Midwest Conference on Theoretical Physics, Indiana University, May 20-21, 1966. Lichtenberg, D. B. (ed.). Bloomington, Ind., Indiana University, 1966.

See CONF-660545.

Baryon resonances are briefly reviewed. Then a model based on what is essentially a molecular viewpoint, that the resonant states are composites of three quarks is described. The set of quarks make up a triplet with respect to SU(3), and they form an isospin doublet and a singlet. Meson states are also considered. (J.F.P.)

46540 INTERFERENCE PHENOMENA ASSOCIATED WITH BOSON RESONANCE PRODUCTION. Goldhaber, Gerson (Univ. of California, Berkeley). Phys. Rev. Lett., 19: 976-8(Oct. 23, 1967).

It is suggested that the peculiar variation in structure observed in the $K\pi\pi$ mass enhancement in the region 1.1 to 1.4 BeV as a function of incident momentum could be primarily due to interference between two resonances with the same J^P values. (auth)

46541 REGGE-POLE RESIDUES AND SUPERCONVERGENCE HYPOTHESIS IN THE BARYON–MESON SCATTERING. Kikkawa, K. (Univ. of Rochester, N. Y.). Nuovo Cim. (10), 51A: 852-5(Oct. 1, 1967).

The superconvergence relations of the spin-flip amplitude $B(\nu,t)$ minus certain Regge-pole terms are investigated for baryon-pseudoscalar meson scattering. Under certain assumptions it is shown that the F/D ratio of the Regge residue of the 2^+ tensor meson and the $\frac{1}{2}^+$ baryon is $+\frac{2}{3}$ for the spin-flip amplitude. A similar analysis for the spin-nonflip amplitude shows a contradiction with the results of Barger and Olsson (Phys. Rev., 31: 80 (1966)). (L.B.S.)

46542 REGGE POLES AND RESONANCES IN π^-p CHARGE-EXCHANGE SCATTERING BETWEEN 2.5 AND 6 GeV/c. Baacke, J. (Technische Hochschule, Karlsruhe, Ger.); Yvert, M. Nuovo Cim. (10), 51A: 761-9(Oct. 1, 1967).

π^-p charge-exchange scattering between 2.5 and 6 GeV/c is described by simply adding resonant amplitudes to the dominating ρ-Regge-pole term. From this model the (J – L)-values of the resonances $\Delta(2420)$, N(2640) and $\Delta(2840)$ as well as another hint to a zero of the Regge-pole residue function $b_+(t)$ are obtained. (auth)

46543 DOUBLE REGGE ANALYSIS OF HIGH-ENERGY EXPERIMENTS PRODUCING THREE FINAL PARTICLES. Chan, Hong-mo; Kajantie, K.; Ranft, G.; Beusch, W.; Flaminio, E. (CERN, Geneva). Nuovo Cim. (10), 51A: 696-716(Oct. 1, 1967).

A general systematic analysis based on a double Regge model is suggested for high-energy hadron collisions producing three particles in the final state. It is intended only for events in the central region of the Dalitz plot where all two-particle invariant masses are high. The procedure is described in detail and applied to two existing experiments: A) $\pi^+p \to \pi^+\pi^0p$ at 8 GeV/c, B) $\pi^-p \to K_1^0K_1^0n$ at 12 GeV/c. The results are encouraging. (auth)

46544 MIXING EFFECT BETWEEN PARTICLES AND RESONANCES. Maskawa, Toshihide (Nagoya Univ., Japan); Kondo, Hiroki; Maki, Ziro. Progr. Theor. Phys. (Kyoto), 38: 190-201 (July 1967).

The system of pion, nucleon, and (3–3) particle acting mutually through the Yukawa interaction is investigated by means of the static meson theory. It is assumed that these particles (including the (3–3) particle) can be treated as elementary ones although they are equally constructed from urbaryons. An integral equation for the scattering amplitude is solved in some reasonable approximation. Since the Yukawa interaction is strong enough to produce resonances between pion and nucleon, one may expect that two resonances (or bound states) exist in the (3–3) state of pion-nucleon scattering. In fact, the solution with two resonances is obtained in case the mixing energy is small. It is shown, however, that one of them disappears when the mixing energy increases. (auth)

46545 ρ-MESON NUCLEON SCATTERING AS AN INELASTIC CHANNEL OF P_{11} PION–NUCLEON SCATTERING. Kanki, Takeshi (Osaka Univ.). Progr. Theor. Phys. (Kyoto), 38: 172-81(July 1967).

It is shown that in the p-wave $I = J = \frac{1}{2}$ ρ-meson nucleon scattering, the N* (1236 MeV 3–3 πN resonance) exchange force is attractive and possibly strong. In the static single channel calculations, an existence of a bound state in this channel is then suggested. This bound state can decay into the πN or $\pi\pi$N state when the $\rho \to 2\pi$ decay interaction is introduced. The connection between this bound state and the Roper resonance, which has the same quantum number as the nucleon and the mass about 1400 MeV, in pion-nucleon scattering is discussed. (auth)

46546 HIGH-ENERGY NUCLEON SCATTERING. Wilson, Richard. Comments Nucl. Particle Phys., 1: 160-3(Sept.-Oct. 1967).

Some of the recent refinements in high-energy nucleon scattering experiments are discussed. Various features of the Pomeranchuk theorem, dispersion relations, and large-momentum transfers for πp and pp scattering are pointed out. (L.B.S.)

Strong (Baryon No. ≥ 2)

46547 (IPNO/TH–88) ONDE S PION–PION ET INTERACTION NUCLEON–NUCLEON. (Pion–Pion S Wave and Nucleon–Nucleon Interaction). Gauron, P. (Paris Univ., Orsay (France). Institut de Physique Nucleaire). May 1967. 6p. (In French). Dep.

The nucleon-nucleon phase shift was calculated using a pion-pion S wave model. The parameters of this model were fixed by means of experimental results on pion-nucleon scattering. The results show that the two π basic term is weak and can be neglected. The introduction of the pion-pion S wave model made it possible to include the contribution of ω in the experimental results. (J.S.R.)

46548 PROTON–PROTON BREMSSTRAHLUNG. Reitan, Arne (Norges Tekniske Hoegskole, Trondheim, Norway). Nucl. Phys., B3: 147-54(1967).

The differential and total cross section for the reaction $p + p \to p + p + \gamma$ are evaluated by using a transition operator consisting of the standard electromagnetic interaction plus a part arising from exchange of pions between the two nucleons. The latter processes are treated by a simple semiphenomenological model. Only transitions to the final $^1S_0$ state are considered. The results are compared with experiments at 200 MeV incident laboratory energy. (auth)

46549 POSSIBILITY OF OBTAINING PARTICLE SCATTERING AMPLITUDES FROM NUCLEAR SCATTERING PROCESSES. Formanek, J.; Trefil, J. S. (CERN, Geneva). Nucl. Phys., B3: 155-72(1967).

The differential cross sections are calculated for the reactions of the type $^4He(\pi,M)^4He$ and $^4He(p,B)^4He$ when M is any meson resonance, and B is any baryon resonance, in the framework of the Glauber model. It is shown that accurate measurement of the position and the depth of the first minimum in these cross sections can be used to give both the magnitude and the phase of the M nucleon and B nucleon scattering amplitude. (auth)

46550 INELASTIC INTERACTIONS OF PARTICLES AT HIGH ENERGIES. II. ENERGY AND ANGULAR DISTRIBUTIONS OF SECONDARY PARTICLES. Barashenkov, V. S.; Maltsev, V. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Fortschr. Phys., 15: 435-94(1967).

The properties of secondary particles produced from inelastic interactions of high energy particles are reviewed. The properties studied are related to energy, momentum and angular distributions of the particles. Restriction is made to the energy region $T \gtrsim 1$ GeV (T is the kinetic energy of the primary particle in the laboratory system). However, data concerning the antinucleon annihilation is considered for all energies starting at the threshold T = 0. The available experimental data are summarized and analyzed independently of preconceived theoretical predictions. (J.F.P.)

46551 PROTON–PROTON BREMSSTRAHLUNG. Reitan, Arne. (Norges Tekniske Hoegskole, Trondheim, Norway). Ark. Fys. Seminar Trondheim, No. 9, 16p.(1967).

The differential and total cross section for the reaction $p + p \to p + p + \gamma$ are evaluated by using a transition operator consisting of the standard electromagnetic interaction plus a part arising from exchange of pions between the two nucleons. The latter processes are treated by a simple semiphenomenological model. Only transitions to the final $^1S_0$ state are considered. The results are compared with experiments at 200 MeV incident laboratory energy. (auth)

46552 THE HYPERNUCLEUS $^6He_\Lambda$. Lovitch, L. (Istituto Nazionale di Fisica Nucleare, Pisa, Italy); Rosati, S. Nuovo Cim. (10), 51A: 647-63(Oct. 1, 1967).

The existence of the hypernucleus $^6He_\Lambda$ has been recently established on the basis of the experimental observation of a few decay events. Earlier calculations on the structure of this system gave contrasting results for its stability relative to the decay $^6He_\Lambda \to {}^5He_\Lambda + n$. The problem is re-examined with a method which permits greater accuracy for the binding energy, and it is concluded that the disagreement between previous results follows from the insufficiently flexible trial wave functions used by some of these authors. With the various phenomenological potentials which are presently available to describe the interactions between the particles that compose the hypernucleus, it is found that $^6He_\Lambda$ is particle stable with a binding energy for the last neutron B_n which lies between about 0.1 and 0.5 MeV. The presence of a spurious alpha-neutron s-state component in the wave function has a negligible effect on this result. (auth)

46553 VELOCITY DEPENDENT OBEP AND NUCLEON–NUCLEON SCATTERING PHASE SHIFT IN THE BORN APPROXIMATION. Sharma, Ravi D.; Green, A. E. S. (Univ. of Florida, Gainesville). Nucl. Phys., B3: 33-46(1967).

Relativistic OBEP containing important velocity dependent terms in the Schrödinger–Pauli limit are treated in the Born approximation. The N-N elastic scattering phase shifts are calculated and the results are compared with exact calculations of the phase shifts. It is found that the Born approximation can be relied upon for D and higher waves and gives reasonable trends for the P-waves. Two methods of treating the velocity dependence in the Born approximation are discussed. It is shown that direct Born approximation treatment of velocity-dependent potentials is valid

when the effective mass method breaks down. Three different OBEP arising from different treatments of a vector meson field are studied in detail and are found to give similar results for D-waves and higher but differ significantly in the $^1P_0$ phase shift. (auth)

46554 ON THE MECHANISM OF HIGH-ENERGY NUCLEON–NUCLEUS COLLISIONS. Shen, Ming-liang (Franklin Inst., Swarthmore, Pa.). Nucl. Phys., B3: 77-88(1967).

Interpretation of existing data concerning nucleon-nucleus interactions in the high energy region (>10 GeV) is demonstrated to be unsatisfactory when based on the cascade mechanism alone. A model similar to the "tube" mechanism is proposed, and several relations are derived which fit the experimental data rather well. (auth)

46555 DEUTERON VERTEX FUNCTION IN DISPERSION THEORY. Harkness, Richard Long Jr. Bloomington, Ind., Indiana Univ., 1965. 52p.

Thesis.

Form factors are shown to arise in practical applications of S-matrix theory, and are used to restore the effects of certain neglected terms which account for the structure of one or more particles participating in a scattering process. These ordinarily neglected terms are shown to be especially important in the case of a weakly bound composite particle, for in this case they contribute a so-called "anomalous threshold." The reaction $p + p \rightarrow \pi^+ + D$ is analyzed and a family of terms which appear in the amplitude is isolated and defined to be the form factor of the deuteron. The resulting form factor is essentially the vertex function of field theory. Neglecting spin and postulating unsubtracted dispersion relations, a first order approximation to the deuteron vertex function is explicitly evaluated. The approximation amounts to assuming that the deuteron is bound by single pion exchange. The first order expression is shown to generate an anomalous threshold when the binding energy is decreased sufficiently. The mechanism by which the a.t. arises are thoroughly explored. The nonrelativistic limit of the anomalous term in the vertex function is shown to correspond to the Schroedinger wave function of the deuteron calculated with a Yukawa potential for single pion exchange. This correspondence is interpreted in terms of the large size of the deuteron compared to a pion Compton wavelength, and is further demonstrated by showing that the anomalous term in the vertex function determines the low energy properties of the relativistic deuteron photodisintegration amplitude in the same way that the wave function of the deuteron influences the nonrelativistic calculation of the same amplitude in the impulse approximation. Finally the same form factor is evaluated again, this time incorporating spin in a fully relativistic formalism and using rho as well as pion exchange in the model of the deuteron in an effort to fit an empirical form factor of the deuteron derived elsewhere. The empirical form factor shows strong evidence of a hard core in the deuteron and provides an acid test of any theory of deuteron structure at small distances. (Disser. Abstr.)

Particle Invariance Principles and Symmetries

General

46556 (CERN-67-27) SELECTED TOPICS ON VIOLATION OF CP INVARIANCE. Caneschi, L.; Van Hove, L. (European Organization for Nuclear Research, Geneva (Switzerland)). 1967. 53p. Dep.

The discussion of CP violation includes the $K^0-\overline{K}^0$ system, $K_L^0 \rightarrow 2\pi$ without CP violation, strong or electromagnetic violation of CP, η decay, and the neutral K system. Also considered are consequences of CPT invariance and CP invariance, and the superweak model and models with phase mismatch. (J.F.P.)

46557 REPRESENTATION OF CURRENT ALGEBRAIC RELATIONS IN THE SPACE OF RELATIVISTIC TWO-PARTICLE STATES. Goldberg, Haim (Univ. of Tel-Aviv, Israel). Nucl. Phys., B3: 173-80(1967).

Current densities which transform two-particle states into two-particle states are constructed by the application of a formal procedure. Current algebraic relations are imposed on these densities, and the implied nonlinear integral equations are written. (auth)

46558 APPLIED GROUP THEORY. Hall, G. G. Mathematical Physics Series. New York, American Elsevier Publishing Co., Inc., 1967. 133p. $6.00.

After a discussion of pure group theory, the emphasis is shifted from the theory of matrix representations of groups to the theory of algebras. Thus the theory of group characters emerges as a by-product of the discussion of how operators which reduce the group multiplication table to diagonal form can be defined. The projection operators which achieve this diagonalization are also those which produce the symmetry-adapted vectors needed in most applications. An alternative method for building character tables is described, and the theory of continuous groups is approached in terms of Lie algebras. A major objective is an understanding of the spin representations of the rotation group. Finally the problem of simplifying direct object representations, which arises in the N-particle problem, is introduced. (J.F.P.)

46559 WHAT ARE SU(6)'S? Coleman, Sidney (Harvard Univ., Cambridge, Mass.). pp 129-42 of Proceedings of the 1966 Midwest Conference of Theoretical Physics, Indiana University, May 20-21, 1966. Lichtenberg, D. B. (ed.). Bloomington, Ind., Indiana University, 1966.

See CONF-660545.

The various theories of SU(6) are described and reviewed. Eight classes of SU(6) theory and the difficulty associated with each are listed. (J.F.P.)

46560 LOCALIZED STATES AND GROUP CONTRACTION IN 4 + 2 DE SITTER SPACE. Maduemezia, Awele (IAEA, Trieste, Italy). Nuovo Cim. (10), 51A: 585-601(Oct. 1, 1967).

A detailed study is made of the problem of imbedding space-time in 4 + 2 de Sitter space. It is shown that such an imbedding invariably leads to a contraction of the group $O_{4,2}$ and to a restriction of the Poincaré group operations to a spacelike surface in space-time. Localized particle states are constructed as normalizable eigenfunctions of the mass-squared operator. Explicit expressions for relativistic position operators are derived from the contraction of the algebra of the group $O_{4,2}$ introduced by a certain limit-taking involved in the space-time imbedding process. (auth)

46561 ONE-PARAMETER SYMMETRY TRANSFORMATIONS. Reeh, H. (Max Planck Institut fuer Physik und Astrophysik, Munich). Nuovo Cim. (10), 51A: 638-46(Oct. 1, 1967).

A theorem is proved for one-parameter groups of automorphisms commuting with the time translations. (auth)

46562 SOME UNITARY REPRESENTATIONS OF $SU_{p,q}$ GROUPS. Hillion, P. (Paris Univ.). Nuovo Cim. (10), 51A: 674-86(Oct. 1, 1967).

A discussion is given of some continuous unitary irreducible representations of $SU_{p,q}$ groups in Hilbert spaces $L^2(X_i)$, where X_i denotes the homogeneous space $SU_{p,q}|G_i$. G_i being a closed subgroup of $SU_{p,q}$. It is shown how the principal series and the principal discrete degenerate series can be realized with a view to their possible use in high-energy physics. (auth)

46563 A REMARK ON INTERPRETING MAJORANA'S EQUATION. Biehenharn, L. C.; Giovannini, A. (International Centre for Theoretical Physics, Trieste, Italy). Nuovo Cim. (10), 51A: 870-2(Oct. 1, 1967).

A simple interpretation of Majorana's result is given in terms of an hypothesized deeper level of structure; from this point of view the Majorana equation is a model of a system which demonstrates the distinction between physical substructure and mathematical substructure. (L.B.S.)

46564 FIELD EQUATIONS FOR REALIZATION OF THE INHOMOGENEOUS DE SITTER GROUP. Bakri, M. M. (Cairo Univ., Giza). Nuovo Cim. (10), 51A: 864-9(Oct. 1, 1967).

The structure of the generators of the inhomogeneous de Sitter group is considered, and field equations satisfied by its finite-dimensional irreducible realizations with $p_A p_A = 0$, where p_k denotes the Cartesian components of momentum, are derived. (L.B.S.)

46565 EMBEDDING OF INHOMOGENEOUS PSEUDO-ORTHOGONAL GROUPS. Pinski, G. (Drexel Inst. of Tech., Philadelphia). Nuovo Cim. (10), 51A: 856-7(Oct. 1, 1967).

An explicit construction is used to prove a theorem on the embedding of an arbitrary inhomogeneous pseudo-orthogonal group in larger homogeneous groups. It is shown that $I_{p,q} \subset O_{p+1,q+1}$. Examples are shown as special cases. (L.B.S.)

46566 SELF-CONSISTENT DEVIATIONS FROM SU_3 SYMMETRY: SOME GENERAL COMMENTS. Williams, P. G. (Queen Mary Coll., London). Nuovo Cim. (10), 51A: 770-800 (Oct. 1, 1967).

It is shown how the general properties of SU_3 crossing matrices and Racah coefficients make it possible to project out different types of first-order-symmetry-breaking terms in a self-consistent calculation. General expressions are given for coupling and mass deviations, and a graphical method is developed enabling one to follow the complicated algebra in some detail. (auth)

46567 REMARKS ON THE METHOD OF INFINITE-COMPONENT WAVE EQUATION FOR RELATIVISTIC MODEL WITH INTERNAL STRUCTURE. Takabayasi, Takehiko (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto), 38: 287-9(July 1967).

After remarking on the wave equation leading to a relativistic rotator mass formula, a simple variation of it is considered in comparison with Majorana theory. Then, from the context the relativistic wave equation with oscillator mass spectrum based on the wider 0(4,2) group is briefly noted to illustrate that the method infinite-component function is generally equivalent to the method of continuous kinematical variables describing internal motion and thus gives a succinct representation of treating a relativistic model with internal movement. (J.F.P.)

Applications (Electromagnetic and Weak)

46568 C-VIOLATION AND ELECTROPRODUCTION OF THE $N_\delta(1238)$ ISOBAR. Chkareuli, Dzh. L. pp 76-9 of Yadernye Vzaimodeistviya pri Vysokikh Energiyakh. Tbilisi, USSR, Metsniereba Publishing House, 1966. (In Russian).

The reaction $e + p \rightarrow e + N_\delta$ (1238) was analyzed to seek possible verification of the hypothesis of C-violation. It was found that if C-violation occurs in that reaction it must be sought outside the interval of q^2 values of $2-100\ F^{-2}$. (JPRS)

46569 LIMITS ON SYMMETRY-BREAKING ELECTROMAGNETIC INTERACTIONS OF THE ELECTRON AND PROTON. Margolis, B.; Robertson, D. (McGill Univ., Montreal). Nuovo Cim. (10), 51A: 736-43(Oct. 1, 1967).

The experimental limits on the parity-violating polarization in electron-proton scattering are used to obtain limits on C- and P-violating electromagnetic interactions of the electron and proton. The effect of an electric-dipole moment of the proton on electron-proton scattering is discussed, and the cross section is given including all proton spins. (auth)

46570 WEINBERG SUM RULES AND SCALAR MESONS. de Alwis, S. P. (Cambridge Univ., Eng.). Nuovo Cim. (10), 51A: 846-51(Oct. 1, 1967).

Two sum rules recently derived by Weinberg (Phys. Rev. Lett., 18: 507 (1967)) for the spectral functions of the axial and vector currents using the SU(2) × SU(2) algebra are generalized to SU(3) × SU(3) by including scalar-meson states. It is found that the saturation of the second sum rule with low lying resonances is less justifiable than the corresponding procedure for the first. The experimental data for decay widths of ρ and K* are used together with first sum rule to obtain predictions for the decay widths of a proposed scalar meson. (L.B.S.)

46571 NONORTHOGONALITY OF THE LONG- AND SHORT-LIVED NEUTRAL KAON STATES AND PHENOMENOLOGICAL ANALYSIS OF EXPERIMENTS ON CP NONCONSERVATION IN K^0 DECAY. Bennett, Sheldon; Nygren, David; Saal, Harry; Steinberger, Jack; Sunderland, John (Columbia Univ., New York). Phys. Rev. Lett., 19: 997-9(Oct. 23, 1967).

It is noted that the nonzero charge asymmetry in the $(K_L)_{e3}$ decay demonstrates the nonorthogonality of the K_L^0 and K_S^0 states. A previous result on the charge asymmetry, combined with other measurements relevant to CP nonconservation in K decay, are found to be consistent with a phenomenological analysis, which yields a pion-pion scattering phase shift consistent with other indirect observations only if the mass difference $m_L - m_S$ is negative. (auth)

Applications (Strong)

46572 (JINR-P2-3478) ELEKTROMAGNITNYE SVOISTVA ADRONOV V CHASTICHNOI SIMMETRII. (Electromagnetic Properties of Hadrons in Partial Symmetry). Akhmed, K.; Vinogradov, V. M.; Enkovski, L.; Kukhtin, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 5p. (In Russian). Dep.

In the framework of the partial symmetry suggested by Schwinger the magnetic moments of baryons and Ω^--hyperon related to the proton magnetic moment are obtained. The probabilities of radiative decays of the type $V \rightarrow P\gamma$ and the constants of magnetic dipole decuplet–octet transitions are calculated. (auth)

46573 (LPTHE-TH-214) STRONG DECAYS OF BARYONIC RESONANCES $^3/_2^-$ IN BARYONS AND PSEUDOSCALAR MESONS AND SU(3) SYMMETRY. Cremmer, E. (Paris Univ., Orsay (France). Laboratoire de Physique Theorique et Hautes Energies). Sept. 1967. 16p. Dep.

The strong decays of $^3/_2^-$ of baryonic resonances into baryons and pseudoscalar mesons were studied in the framework of SU(3) symmetry. It is shown that the results are in agreement with experiment by using a Lorentz invariant form for the transition matrix element and taking into account the $Y_0^* - Y_0'^*$ mixing. (auth)

46574 COUPLING CONSTANTS OF MESONS WITH BARYONS IN THE STATIC MODEL OF THE BROKEN SU(6)-SYMMETRY. Rekalo, M. P. (Kharkov Inst. of Physics and Tech.). Ukr. Fiz. Zh., 12: 1299-1303(Aug. 1967). (In Russian).

On the basis of the static model of the SU(6)-symmetry the coupling constants of baryons with mesons are investigated. The violation of the SU(6)-symmetry with a hamiltonian which is transformed like the components of 35-plet is taken into account. Sum rules for the coupling constants of the g (B_δ, BP) type and the relations between the coupling constants g (B_δ, Bπ) and g (B, Bπ) are found. (auth)

46575 DECAY RATES OF K*(1420) AND THE 2^+ NONET. Bassano, D. (Syracuse Univ., N. Y.); Goldberg, M.; Goz, B.; Pertile, G.; Barnes, V. E.; Dornan, P. J.; Kalbfleisch, G. R.; Samios, N. P.; Skillicorn, I. O. Phys. Rev. Lett., 19: 968-71 (Oct. 23, 1967). (BNL-11736).

The agreement with unbroken SU(3) predictions for the 2^+ mesons is re-examined in the light of new decay-rate information for the K*(1420), which is presented, together with improved results for the f*(1500) discussed previously. (J.F.P.)

46576 BARYON RESONANCES IN SU(3). Tripp, R. D. (Univ. of California, Berkeley); Leith, D. W. G.; Minten, A.; (and others). Contract W-7405-Eng-48. Nucl. Phys., B3: 10-20(1967). (UCRL-17385(Rev.)).

An attempt is made to place most of the known baryon resonances into SU(3) multiplets, after which a comprehensive comparison of decay rates is made in graphical form. (auth)

46577 SYSTEMATICS AND PHENOMENOLOGY OF THE STRONG INTERACTION OF BARYONS. Kaiba, Masayuki; Matumoto, Ken-iti (Kanazawa Univ., Japan). Progr. Theor. Phys. (Kyoto), 38: 182-9(July 1967).

The characteristics of the strong interaction of baryons are investigated phenomenologically. It is shown that U(3)-invariance is fairly well satisfied in the strong interactions of baryons. The validity of U(3)-invariance seems to give a new clue for classifying various baryons into U(3)-multiplets. For example, it is shown that $Y_1^*(J^P = {}^5/_2^-)$ is a member of unitary octet together with $N_\delta^*(J^P = {}^5/_2^-)$. The characteristics of the strong decay of several undiscovered baryons are predicted. The characteristics beyond U(3)-invariance of the strong interaction of baryons are examined in detail. (auth)

46578 S-MATRIX APPROACH TO STRONG-INTERACTION SYMMETRIES. Roy, Shasanka Mohan. Princeton, N. J., Princeton Univ., 1966. 108p.

Thesis.

Defining an internal symmetry to correspond to the existence of an energy and angle-independent real orthogonal matrix U diagonalizing the S-matrix, a method was developed to determine permitted internal symmetries by a rigorous application of unitarity and crossing. Using this method it is shown that for the system of pions and kaons, the least trivial internal symmetry (in the sense explained in the text) is that corresponding to isotopic spin. Accepting then that the particles break up into isotopic spin states the scattering of the 8 ps mesons (π, η, K) is discussed. If it is required that each of the scattering matrices in the problem be diagonalized by a constant real matrix U, it is found that the only non-trivial amplitude relations are precisely those given by SU(3). If the diagonalization conditions are truncated such that the η meson is allowed to have a mass different from the π and the K mesons, the least trivial set of amplitude relations is found to be that given by G_2. In the next step it is shown that internal symmetry coupling constant relations can be derived from the much weaker hypothesis of energy-independent diagonalization of just the relevant partial wave amplitudes. Finally, keeping in view the actual experimental situation where no exact symmetry exists, a simple method to compute directly the energy dependent orthogonal matrix diagonalizing the S-matrix is developed. This leads to derivation of dynamical coupling constant sum rules, which are evaluated in a number of simple cases. Numerical results are given for the couplings of the $\pi\pi$ and $K\bar{K}$ channels to the vector mesons, and their approach to the internal symmetry limit as the K-mass approaches the π-mass is studied. (Disser. Abstr.)

Quantum Field Theories

46579 (CTS-HE-67-6) SELF-COUPLED REPRESENTATIONS OF THE LORENTZ GROUP AND INFINITE-COMPONENT

FIELDS. Todorov, Ivan T. (Miami Univ., Coral Gables, Fla. Center for Theoretical Studies). Sept. 1967. 40p.

A concise review of recent work on infinite-component fields is presented. Attempts to dispense with the restriction of finite-component fields and finite-dimensional representations of SL(2,C) for the covariance law for the field in relativistic quantum field theory are reviewed, and infinite-component quantized fields are considered. It is found that many results of conventional quantum field theory such as TCP and spin and statistics crucially depend on the assumption that a certain transformation in the covariance law for the field in relativistic quantum field theory is finite dimensional. (J.F.P.)

46580 DERIVATION OF RENORMALIZED RELATIVISTIC PERTURBATION THEORY FROM FINITE LOCAL FIELD EQUATIONS. Brandt, Richard A. (Univ. of Maryland, College Park). Ann. Phys., (N.Y.), 44: 221-65(Sept. 1967).

An hypothesis of K. Wilson is investigated for the behavior of a product of an arbitrary number of interacting field operators, when evaluated near the same point. The hypothesis suggests that an appropriate field equation for neutral pseudoscalar meson theory is $(i\gamma\cdot\partial - m)\psi(x) = ig \lim_{\xi\to 0} E_1^{-1}(\xi)[\psi(x)\phi(x-\xi) - E_1(\xi)\psi(x) - E_{2\mu}(\xi)\partial^\mu\psi(x)]$ for suitable functions $E_i(\xi)$ with singularities at $\xi = 0$. It is shown that E_i exist such that the renormalized integral equations implied by this equation are valid in all orders of renormalized perturbation theory. Since the iterative solutions of these integral equations are equivalent to conventional perturbation theory, it follows that this theory can be based on finite field equations. A suitable set of E_i's is exhibited in terms of renormalized Green's functions; and it is shown that different sets correspond to finite renormalizations of the relevant parameters. The work is based on rigorously proved properties of renormalization theory and is applicable to any renormalizable field theory. (auth)

46581 REFINED SOLUTION OF TWO-DIMENSIONAL-MODEL THEORIES. Schwabl, F. (IAEA, Trieste, Italy); Thirring, W.; Wess, J. Ann. Phys. (N. Y.), 44: 200-20(Sept. 1967).

In the formulation of the model, special care was given to the definition of the current as the product of field operators. It is shown that a product of field operators, where the space-time points coincide, can be defined as the limit of products with the points separated and that the limit exists in the Borchers topology. A consistent definition of the current can be given this way, and the model in which a massive vector field is coupled to this current is solved through an ansatz. The interacting fields can be expressed in terms of free canonical quantities. To avoid infrared divergences, a finite volume is used. (auth)

46582 PHYSICAL EQUIVALENCE OF REPRESENTATIONS RELATED TO AUTOMORPHISM. Vasil'ev, A. N. (Leningrad State Univ.). Zh. Eksp. Teor. Fiz., 53: 994-1002(Sept. 1967). (In Russian).

The relation between field theories in which the field operators can be mutually and uniquely expressed in terms of each other is considered. In the Wightman axiomatics the Wightman functionals correspond to such theories. These functionals are related by automorphism $W \rightleftharpoons W_\tau$ where $W_\tau(a) = W(\tau^{-1} a)$ (a is an arbitrary element of field algebra A and τ is fixed automorphism of A). It is demonstrated that despite their external differences such theories can be interpreted as being different variants of description of a single physical system. The W and W_τ symmetry groups are externally different but yield unitary-equivalent representations of the same abstract symmetry group. Arguments are presented in favor of the viewpoint that in the scattering theory prescription of the Hamiltonian as a function of the production and annihilation operators uniquely determines the representation of the latter. (auth)

46583 SYSTEM WITH A HAMILTONIAN IN THE FORM OF A TIME-DEPENDENT QUADRATIC FORM OF x AND p. Chernikov, N. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz., 53: 1006-17(Sept. 1967). (In Russian).

The solution of the Schroedinger equation can algebraically be expressed in terms of the solution of the classical Hamilton equations provided the hamiltonian is a quadratic form of the coordinates and momenta and the coefficients of the form are arbitrary functions of time. The Fock representation is introduced for such a system. The results are useful in formulating quantum field theory in an arbitrary space-time world. (auth)

46584 COVARIANCE OF EQUAL-TIME COMMUTATORS AND SUM RULES. Bollini, C. G.; Giambiagi, J. J.; Tiomno, J. (International Atomic Energy Agency, Trieste, Italy). Nuovo Cim. (10), 51A: 717-27(Oct. 1, 1967).

Conditions for covariance of equal-time commutators are given. In momentum space they imply relations among the invariant amplitudes. It is shown that the most general expressions for the sum rule, in any particular frame, is $\int d\tau n^\mu t_\mu(k^\nu + \tau n^\nu) =$ form factor, where n_μ is an arbitrary timelike vector. The covariance conditions are expressed by the fact that the integral is n-independent. In particular, Fubini's sum rule, which corresponds to a choice of n in the light cone, in spite of being covariant must be supplemented with a set of covariance conditions. (auth)

46585 GENERAL SOLUTIONS TO THE BETHE–SALPETER EQUATION OF THE UNEQUAL-MASS WICK–CUTKOSKY MODEL. Nakanishi, Noboru (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), 38: 226-45(July 1967).

General solutions to the Bethe-Salpeter Equation of the Wick-Cutkosky model are obtained in various forms not only for the case in which the total four-momentum of the system is time-like or space-like but also for the case in which it is light-like. (auth)

46586 HADRON CONTRIBUTIONS TO HIGH-ENERGY QUANTUM ELECTRODYNAMICS. Pfister, H. (Univ., Munich). Z. Phys., 206: 75-83(1967).

Without taking into account the electromagnetic structure, caused by the strong interactions, all charged particles contribute with nearly the same weight to the electromagnetic vacuum polarization at very high energy. The structure effects come in via the form factors at timelike momentum transfer. By making use of the strong asymptotic decrease of the nucleon form factors for spacelike argument, it is inferred from an unsubtracted dispersion relation that the nucleon contributon to vacuum polarization can be neglected asymptotically, compared to the contribution of the unstructured leptons. (auth)

46587 ASYMPTOTIC QUANTUM FIELD THEORY. Chen, Tuan Wu. Syracuse, N. Y., Syracuse Univ., 1966. 86p.

Thesis.

A quantum field theory is formulated with the following features: (1) It is free of divergences and also free of the unphysical procedure of renormalization. (2) The interaction can be specified in the dynamical equation. (3) It gives consistent (renormalized) results for a renormalizable interaction and (4) It is also applicable to a non-renormalizable interaction. Also the question of further weakening our assumptions is investigated. The formulation assumes the Bogolyubov causality condition, the strong unitarity condition, the asymptotic condition, the completeness of the in-field (or out-field) and Lorentz covariance. The off as well as on mass-shell values play an important role in the formulation and they are treated carefully by employing the operator derivatives with respect to the infield which satisfies the weak (or ordinary) free field equation. A dynamical equation which determines all S-matrix elements is developed. The specification of interactions is made in this equation. It is then shown that finite perturbative solutions exist to all orders and that the scattering matrix elements can be obtained by imposing suitable boundary conditions. No restrictions on the types of interactions appear in the formulation and, therefore, the same procedure can be carried out for renormalizable as well as for non-renormalizable interactions. For renormalizable interactions, in particular, the dynamical equation reduces to the one postulated in a previous formulation by Pugh. Finally it is proved that the strong unitarity condition does not need to be assumed for renormalizable interactions because this strong condition follows from weak (or ordinary) unitarity and the other assumptions. (Disser. Abstr.)

46588 LECTURES ON QUANTUM FIELD THEORY. Dirac, P. A. M. Belfer Graduate School of Science Monographs Series. Number Three. New York, Yeshiva University, 1966. 156p. Academic Press, New York $7.50.

The treatment of quantum field theory is based on the Hamiltonian formalism and the theory is developed with results following from the equations of motion. The relationship of the Heisenberg and Schroedinger pictures is first discussed. Other topics include basic quantum concepts; Fock representation; second quantization; relativistic invariance of the scalar field and the electron field; quantum electrodynamics; mass renormalization; and the Lamb shift. (L.B.S.)

46589 GLOBAL TECHNIQUE FOR THE STUDY OF SPINOR FIELDS. Grgin, Emil. Syracuse, n. Y., Syracuse Univ., 1966. 69p.

Thesis.

The conformal transformations of the Minkowski space into itself are first studied in the most convenient formalism for that purpose: The polyspherical coordinates. This formalism is based on the fact that the conformal compactification of the Minkowski space is homeomorphic with a quadric in a five-dimensional projective space. Such a quadric is, in turn, homeomorphic with a kind of four-dimensional torus. As a consequence, this torus is

homeomorphic with the conformal compactification of the Minkowski space. The relation between these two spaces is analogous to the relation between the Euclidian plane and its stereographic (i.e., conformal) compactification: The two-dimensional sphere. A system of coordinates (called "tore coordinates") is, then, introduced to parametrize the torus in a manifestly compact way. These coordinates are analogous to the polar coordinates on the sphere. In tore coordinates, the formalism for the study of the conformal compactification of the Minkowski space is that of Riemannian geometry, the torus being a compact Riemannian space. A theorem, according to which the eigenfunctions of the Laplace operator in a compact Riemannian space form a complete basis for the Hilbert space of square-integrable functions over that space, is then, used, and the complete set of eigenfunctions of the D'Alambertian over the torus is calculated. Essentially, these eigenfunctions are the generalized spherical harmonics. Harmonic analysis is, then, used to solve the zero-rest-mass free-field spin-s equations for arbitrary, integer, half-odd, or vanishing values of s. The corresponding solutions of the spin-s field in Minkowski space are obtained by a simple conformal transformation of the solutions on the torus. In general, the spin-s fields are multi-valued over the simple conformal compactification of the Minkowski space — their periodicity depending on the value of s. They are made univalent by the application of the idea of the Riemann surface. The procedure leads to the concept of the p-sheeted compactification of the Minkowski space. (Disser. Abstr.)

46590 STATE VECTOR SPACES WITH INDEFINITE METRIC IN QUANTUM FIELD THEORY. Nagy, K. L. Groningen, The Netherlands, P. Noordhoff Ltd., 1966. 139p.

MS revised by G. Marx and J. Bognar.

The general properties of state vector spaces with indefinite metric, with the physical theories in which the indefinite metric plays an important role are considered. Problems related to the probabilistic interpretation and to the changes in the analytical properties of the field theoretical amplitudes, etc. are also discussed. (J.F.P.)

Scattering Theory

Refer also to abstract 46819.

46591 (ITF-67-7) EQUATION FOR THE RELATIVISTIC SCATTERING AMPLITUDE. Kadyshevskii, V. G. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1967. 35p. Dep.

A quasipotential equation is derived for the two-body scattering amplitude. When considering the Lorentz-invariant amplitudes a somewhat different normalization, which is more convenient for the relativistic case, is used. The corresponding integral equations involve factors which do not transform to unity in the nonrelativistic limit. The derivation shows that this equation plays the same role in the formalism as the Bethe–Salpeter equation in an ordinary treatment. Under these circumstances the kernel of the equation obtained, the so-called quasipotential, can be constructed from perturbation theory by making use of irreducible diagrams of definite form. (J.F.P.)

46592 BRANCHING POINTS IN A PLANE WITH COMPLEX ANGULAR MOMENTUM AND THE STRUCTURE OF THE DIFFRACTION PEAK. Kanchelí, O. V. pp 46-52 of Yadernye Vzaimodeistviya pri Vysokikh Energiyakh. Tbilisi, USSR, Metsniereba Publishing House, 1966. (In Russian).

The character of the peculiarities of branching points in a plane with complex angular momentum is determined and their role in the asymptotic behavior of the scattering amplitude is examined by using known data on the threshold behavior of the partial amplitudes of an inelastic process. (JPRS)

46593 ASYMPTOTIC BEHAVIOR OF THE AMPLITUDES OF AN INELASTIC PROCESS, AND PARTIAL AMPLITUDES IN A REPRESENTATION WITH GIVEN ORBITAL MOMENTS. Laperashvili, L. V. pp 53-62 of Yadernye Vzaimodeistviya pri Vysokikh Energiyakh. Tbilisi, USSR, Metsniereba Publishing House, 1966. (In Russian).

The asymptotic behavior of the amplitudes of an inelastic process in the relativistic case was studied with the method of addition of momenta as a function of the selected axis of quantization of momenta, in which case the orbital moment figures in the results of the calculations, and the conditions under which a successful selection is made of the axis of quantization along the different momenta were determined. (JPRS)

46594 SUPERCONVERGENCE AND CURRENT ALGEBRA. De Alfaro, V. (Univ., Turin, INFN, Turin); Fubini, S.; Rossetti, C.; Furlan, G. Ann. Phys. (N. Y.), 44: 165-99(Sept. 1967).

Some general features of the superconvergence sum rules and of their saturation are considered. The problem of the structure of current algebra sum rules is also treated, and the presence of non Regge asymptotic behavior is discussed. Finally, current algebra and superconvergence sum rules for higher-spin targets, and their mutual connections are discussed. (auth)

46595 LINEAR DISSIPATIVE SYSTEMS, NONNEGATIVE DEFINITE DISTRIBUTIONAL KERNELS, AND THE BOUNDARY VALUES OF BOUNDED-REAL AND POSITIVE-REAL MATRICES. Beltrami, E. J. (State Univ. of New York, Stony Brook). Contract AF-AFOSR-1154-66. J. Math. Anal. Appl., 19: 231-46 (Aug. 1967).

The various notions of dissipative systems are studied by considering the positivity requirement in detail and by examining the boundary values, taken in the Swartz topology of tempered distributions, of bounded-real and positive-real matrices. In particular, it is shown that if S is the operator which describes a linear time invariant dissipative system, then the kernel of such an operator is a tempered causal distribution and, depending on the formulation, one can estimate that the kernel of either the operator $I - SS^*$ or that of $S + S^*$ must be nonnegative definite in the sense of Bochner–Swartz. If the frequency response of a linear system is tempered then the fact that it satisfies dispersion relations is equivalent to asserting causality. It is shown that such relations are satisfied by the tempered boundary values of certain half-plane holomorphic matrices. To do this a distributional version of a basic L_2 theorem is invoked. Dissipative systems are considered from the scattering and emittance points of view and the related notions of dissipative operator and passive Hilbert systems are briefly viewed. (J.F.P.)

46596 POSITIVE ENERGY BOUND STATES IN QUANTUM MECHANICS. Rokhlenko, A. V. (Inst. of Problems in Material Management, Kiev). Zh. Eksp. Teor. Fiz., 53: 903-11(Sept. 1967). (In Russian).

Conditions are indicated which are sufficient in order that the wave function of the single-particle Schroedinger equation at points of the positive discrete spectrum superimposed on the continuous spectrum be quadratically integrable. This permits one to set up a correspondence between positive energy bound states and the spectrum. Examples of attractive and repulsive interactions producing a positive discrete spectrum are devised by means of separable potentials. The nature of the scattering amplitude and the wave functions at scattering points is studied. The differential scattering cross section on a positive discrete level possesses the characteristic shape of a two-peak curve. If the positive energy bound state is a virtual one, the cross section is given by the Breit–Wigner formula. In this way a parallel between various quasi-particle models and positive energy levels can be drawn. The levels are interpreted as states of unstable equilibrium of a quantum mechanical system. (auth)

46597 RADIATION TRANSPORT EQUATION FOR CORRELATED SCATTERERS. Barabanenkov, Yu. N.; Finkel'berg, V. M. Zh. Eksp. Teor. Fiz., 53: 978-86(Sept. 1967). (In Russian).

A deduction of the equation for radiation transport in scattering media is presented. Underlying the deduction are the general equations for the average over an ensemble of values of the Green function for a scalar wave field (Dyson equation) and the bilinear combination of two Green functions (Bethe–Salpeter equation). The mass operator and intensity operator (kernels of the Dyson and Bethe–Salpeter equations) are represented in the single-group approximation in which wave scattering effects by groups of correlated scatterers are taken into account. The extinction and scattering coefficients of the transport equation can be directly expressed in terms of the Fourier transform of the mass and intensity operators evaluated on the energy surface. The conditions of applicability of the equation are discussed. (auth)

46598 REDUCTION OF THE TWO- AND THREE-PARTICLE THRESHOLD SINGULARITIES. Jacobson, D. A. (Douglas Advanced Research Labs., Huntington Beach, Calif.). Nuovo Cim. (10), 51A: 624-37(Oct. 1, 1967).

By making use of Olive's formulas for the discontinuities of amplitudes across individual cuts, it is shown that reduced amplitudes can be defined free of the three-particle threshold singularity, or alternatively, free of both the two- and three-particle threshold singularities. The reduced amplitudes are defined through linear integral equations in terms of the mass shell scattering amplitudes. (auth)

46599 REMARK ON "THE VALIDITY OF APPROXIMATE THREE-PARTICLE SCATTERING MODELS IN AN EXACTLY SOLUBLE THEORY". Varma, V. S. (Univ. of Delhi). Nuovo Cim. (10), 51A: 862-3(Oct. 1, 1967).

The conclusion arrived at by Choudhury in a recent paper (Nuovo Cimento, 47A: 1(1967)) that the Lovelace approximation to the Faddeev equations presents a far too simplified picture of three-particle scattering is discussed. (L.B.S.)

46600 ON INFINITELY RISING REGGE TRAJECTORIES. Meidner, H. (Univ. of California, Berkeley). Nuovo Cim. (10), 51A: 882-4(Oct. 1, 1967).

Various conditions imposed on Regge-trajectory functions for infinitely rising trajectories are discussed. (L.B.S.)

46601 SUPERCONVERGENCE OF AMPLITUDES INVOLVING MASSLESS PARTICLES. Barut, A. O.; Tchrakian, D. H. (Univ. of Colo., Boulder). Nucl. Phys., B3: 21-4(1967).

Crossing relations of helicity amplitudes involving massless particles are used to determine those amplitudes which are superconvergent thereby extending the previous studies to the massless case. (auth)

46602 ANALYTICAL STUDIES IN CHARGED-PARTICLE PARTIAL-WAVE AMPLITUDE. Mukherjee, S.; Shastry, C. S. (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Phys., B3: 1-9(1967).

Analytical properties of the charged-particle partial-wave amplitude in the complex angular momentum plane are discussed for positive energy. Asymptotic behavior for large values of angular momentum in the right half plane is examined and the validity of the Regge representation is discussed. (auth)

46603 NEW APPROACH TO THE CONSTRUCTION OF MULTICHANNEL AMPLITUDES. Kinoshita, Kisei (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 38: 283-5(July 1967).

The method for obtaining the full amplitude for multichannel scattering is presented. Two steps are followed which are the calculation of the amplitude without channel coupling, then the calculation of the channel coupling effects. (J.F.P.)

46604 COMPOSITENESS CONDITION AND PROPAGATOR. Shirafuji, Takeshi (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), 38: 246-60(July 1967).

The elementary particle transits to the composite one in the limit that the scattering amplitude in the channel communicating with this particle reduces to its one-particle irreducible part. This limiting process is investigated paying special attention to the asymptotic behavior of the propagator of that particle. No approximation like the elastic one is made. It is found that Lehmann's representation of the propagator in the limit needs one subtraction if and only if the self-energy of the elementary particle is divergent. The method is exemplified in the elastic approximation. (auth)

46605 APPLICATION OF THE METHOD OF STATIONARY PHASE TO POTENTIAL SCATTERING THEORY. Hageman, Donald Henry Albert. Los Angeles, Univ. of Southern California, 1967. 181p.

Thesis.

The scattering of a spinless particle by a time-independent potential $V(\vec{r})$ is treated by applying the method of stationary phase first to Feynman's path integral representation of the amplitude or kernel $K(\vec{r}_b, t_b; \vec{r}_a, t_a)$, thus obtaining an approximate kernel $\overline{K}$, then to the corresponding approximate Green's function $\overline{G}(\vec{r}_b, \vec{r}_a, E_o)$, which is defined to be the projection out of $\overline{K}$ of the Fourier component associated with the energy E_o. An approximation to the scattering amplitude is determined directly from $\overline{G}$. The evaluation of the two-dimensional path integral according to the method of stationary phase is carried out explicitly by a technique which is applicable to any number of dimensions; the result is $\overline{K} = (2\pi i\hbar)^{-(n/2)} \Sigma |D|^{\frac{1}{2}} \exp[i(S/\hbar + \nu\pi/2)]$, where n is the number of dimensions, $S = S(\vec{r}_b, t_b; \vec{r}_a, t_a)$ is the classical action, $\vec{r} = (x^{(1)}, \ldots, x^{(n)})$, D is the Van Vleck determinant, and there is a term for each classical path leading from the point $\vec{r}_a$ at time t_a to the point $\vec{r}_b$ at time t_b. The quantity ν is an integer which depends upon the number of times D changes sign along the classical path being considered. Under the definition, $K = 0$ for $t_b < t_a$, K is a Green's function for the time-dependent Schrödinger equation. Also, when V is independent of t, K depends upon the difference, $\tau = t_b - t_a$. It can then be shown that the projection out of K of the Fourier component associated with the energy E_o, $G(\vec{r}_b, \vec{r}_a, E_o) = \int_0^\infty e^{i\sqrt{2}E_o\tau} K(\vec{r}_b, \vec{r}_a; \tau)\, d\tau$, is a Green's function for the time-independent Schrödinger equation. The corresponding approximate Green's function $\overline{G}$ is defined by putting $\overline{K}$ for K on the right-hand side. The approximation method is applied first to the one-dimensional centrifugal potential, a case for which all desired calculations can be performed explicitly. It is shown that $|D| \to \infty$ as the two classical paths connecting (r_a, t_a) to (r_b, t_b) coalesce, that $\overline{G}$ can be calculated by an extension of the method of stationary phase when the energy E_o is such that the two classical paths joining r_a to r_b are close together, and that $\overline{G}$ approaches G asymptotically as r_a and $r_b \to \infty$. The second application of the approximation method is to the Coulomb potential. It is demonstrated that there are two classical paths connecting $(\vec{r}_a, t_a)$ to $(\vec{r}_b, t_b)$ and, after employing an argument involving the similarity of the effective potential to the centrifugal potential made for the purpose of ascertaining the integers ν in eq. (1), that the asymptotic form of the scattering amplitude is correctly determined to within a phase factor in the scattered wave which depends upon the Coulomb parameter η. This factor approaches the exact value asymptotically as η increases numerically. The third application of the approximation method is to a general spherically-symmetric potential which is sufficiently smooth. It is found that the differential cross section determined directly from $\overline{G}$ is the same as that obtained by a purely classical calculation. Additional calculations necessary to obtain an approximate scattering amplitude which contains diffraction effects, and the extension of the method to more complicated collisions are discussed briefly. (Disser. Abstr.)

Particle Accelerators

Refer also to abstracts 46150, 46175, 46279, 46400, and 46962.

46606 (BNL-11759) EFFECTS OF SEXTUPOLES NEAR A ONE-THIRD INTEGRAL ν VALUE IN THE AGS: AN EXAMPLE. Month, M. (Brookhaven National Lab., Upton, N. Y.). Aug. 28, 1967. 18p. Dep. CFSTI.

The theory of sextupole perturbations near a one-third integral ν value in the AGS is tested by comparing results with results of a direct numerical integration of the force equations. The numerical procedure used was developed previously to investigate a slow beam extraction process. (W.H.K.)

46607 (BNL-11760) SUPERPERIOD GRADIENT PERTURBATIONS IN THE AGS STUDIED TO SECOND ORDER. Fulling, S. A. (Brookhaven National Lab., Upton, N. Y.). Aug. 28, 1967. 8p. Dep. CFSTI.

A computer program, ORDER 2, has been written to calculate the betatron parameters ν_p, β_p, α_p, and γ_p to first and second order in the case of any superperiod symmetric distribution of point quadrupoles located at the centers of the straight sections of the AGS. First and second order results from this program are compared with exact values computed with the program BEAM. (W.H.K.)

46608 (BNL-11817) LINAC PHASE ERROR CALCULATIONS. Carter, D. (Brookhaven National Lab., Upton, N. Y.). Aug. 30, 1967. 10p. Dep. CFSTI.

Distributed phase shifts in the resonant cavities of the AGS Conversion linear accelerator are investigated. Dispersion relations and fields are expressed for stabilized cavities, and phase distribution for the AGS Conversion linear accelerator are calculated. (W.H.K.)

46609 (BNL-11818) THEORETICAL ANALYSIS OF GRADIENT PERTURBATIONS IN THE AGS. Fulling, S. A.; Month, M. (Brookhaven National Lab., Upton, N. Y.). Sept. 6, 1967. 22p. Dep. CFSTI.

The problem of a gradient perturbation in an AGS was previously put in the form of an integral equation for a 2×2 matrix. This matrix equation is reduced to an equation for a single complex quantity. This reduced equation is then used to obtain the betatron parameters to all orders in q, and is used for exact solutions for perturbations consisting of a finite series of point quadrupoles. (W.H.K.)

46610 (BNL-11841) FIELD STABILIZATION IN PERIODIC SYSTEMS. Carter, D. (Brookhaven National Lab., Upton, N. Y.). Sept. 21, 1967. 9p. Dep. CFSTI.

Stabilization of periodic fields for any periodic system is described together with a measure of such stabilization. Dispersion relations and fields are expressed for stabilized cavities. (auth)

46611 (BNWL-481-4, pp 34-8) ACCELERATOR ION BEAM CURRENT REGULATOR. Sheen, E. M.; Glass, W. A.; Ratcliffe, C. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Development of a beam current regulator for the PNL positive ion accelerator enabled dosimetry studies using adiabatic calorimeters to be made. This current regulator operates by causing a high voltage deflection system to sweep the beam across a pair of slits and measuring the average current passing through the slits with an electrometer connected to the target. The electrometer output voltage is compared to a reference voltage and the

error voltage is then amplified and converted to a triangular high voltage wave that drives the beam deflection plates. If the beam current stays within the controllable limits, the average current is constant to within the electrometer drift, approximately 0.1% per half hour. (auth)

46612 (INR-790/SLBAL/PL) TOLERANCJE WZDLUZNE W STRUKTURZE PRZYSPIESZAJACEJ AKCELERATORA LINIOWEGC PROTONOW 10 MeV W SWIERKU. (Longitudinal Tolerances in the Accelerating Structure of the 10 MeV Swierk Proton Linear Accelerator). Sura, J. (Institute of Nuclear Research, Warsaw (Poland)). 1967. 20p. (In Polish). Dep.

The tolerances of the accelerating field distribution and drift tube alignment are determined. The respective values are $\delta E_0/E_0 = 1.7\%$ and $\delta Z/\lambda\beta = 0.12\%$. The method of calculation of field correction is given. The effects of vibrations of accelerating structure elements are discussed. (auth)

46613 (JINR-P13-3425) FORMIROVANIE I ULAVLIVANIE GAZOVOI VODORODNOI STRUT V VAKUUME. (Formation and Catching of a Gas Hydrogen Jet in Vacuum). Zolin, L. S.; Nikitin, V. A.; Pilipenko, Yu. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1967. 20p. (In Russian). Dep.

An experimental system for the formation and catching of a gas hydrogen jet in vacuum is described. The diameter of the obtained jet is about 2 cm and the density -10^{-7} g/cm^2. The jet is well caught by a helium condensation pump. The problem is solved of creation of a gas hydrogen target to operate with the internal beam of an accelerator. (auth)

46614 (LA-DC-8377) COMPUTER CONTROL OF THE LOS ALAMOS LINEAR ACCELERATOR. Butler, Harold S. (Los Alamos Scientific Lab., N. Mex.). [1965]. Contract W-7405-eng-36. 22p. (CONF-670307-15). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From National Particle Accelerator Conference, Washington, D. C.

A data acquisition and control system for the 800-MeV proton linear accelerator for the Los Alamos Meson Physics Facility has been designed on the premise that an on-line digital computer affords the best means of maintaining operator control over the machine. The presence in the control system of a computer acting as a large programmable switching device allows the active area of the accelerator control console to be concentrated into just two panels. All information regarding the status of the accelerator, together with the capability for adjusting any control channel in the facility, is provided on these two panels. The central feature of the console is a digital CRT for alphanumeric displays. With this versatile device and the other hardware on the console, the operator will be able to execute such varied and sophisticated tasks as steering the beam down the accelerator, making phase space plots of the beam, and performing parametric studies of the effect of any control channel—all on-line. The concepts embodied in the LAMPF computer control system are being tested and evaluated in a series of experiments referred to as the Mockup Program. The status of these experiments and the associated hardware are described. (auth)

46615 (LA-DC-8616) DATA TRANSMISSION ACROSS HIGH VOLTAGE INTERFACES VIA LIGHT LINKS. Budge, Ezra C. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 7p. (CONF-670307-11). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From National Particle Accelerator Conference, Washington, D. C.

Computer control/monitoring of the LAMPF injector requires data to be transmitted to and from the ion source in the high voltage head. These data must be digitized for computer use as is done throughout the rest of the accelerator. The A/D converter, interfacing instrumentation equipment, and control logic are placed in the head. Signals are transmitted across the 750 kV interface to and from the high voltage head through 5 light links. Four are used to replace insulated rods and strings for data and control. One transmits the pulse signal to the ion source. The system should operate a computer speeds; therefore, rise and fall times for pulse transmission of data must be less than 200 ns. The pulse width is 800 ns with a 50% duty cycle. The ion source pulse requires the same rise time but the pulse width must extend to 1.5 ms. This paper describes the system and reports the test results on a system designed to meet these specifications. The modification of the system to provide linear transmission of fast waveforms is discussed. (auth)

46616 (MPS/EP-26) PARTICLE DYNAMICS IN SEXTUPOLE MAGNETS. King, N. Marshall (European Organization for Nuclear Research, Geneva (Switzerland)). Sept. 5, 1962. 18p. Dep.

The flux of wanted particles in a separated beam may be increased, in principle, by accepting a large momentum spread. However, chromatic aberration effects in the beam system offset the advantages to be gained in this way: image size is increased and separation is reduced. One possible way of improving this situation is to make use of a sextupole magnet element. The principle of the method was described previously, and, for quantitative work a version of TRAMP now exists, capable of matching and tracking particle trajectories through a system containing a sextupole. It is shown how simple approximate solutions to the equations of motion may provide good quantitative estimates of the dynamical effects; in particular, they allow rapid assessment of the sextupole gradient required in a given instance. Correction of chromatic aberration using a sextupole magnet is a matter of refined beam optics: Chadwick has pointed out the particular conditions of operation under which the element should be used. The theory is explicit, and recent experiments in which the effect was not observed may be attributed to failure to meet these conditions. (auth)

46617 (SLAC-PUB-350) PROGRESS REPORT ON BEAM BREAK-UP AT SLAC. Farinholt, E. V.; Helm, R. H.; Hogg, H. A.; Koontz, R. F.; Loew, G. A.; Miller, R. H. (Stanford Linear Accelerator Center, Calif.). Sept. 1967. Contract AT(04-3)-515. 20p. (CONF-670930-6). Dep. CFSTI.

From 6th International Conference on High Energy Accelerators, Cambridge, Mass.

The progress made in the last six months in understanding and remedying the beam breakup effect (BBU) at SLAC is reported. The experimental and theoretical approaches to the BBU problem are discussed. The present hypotheses on noise sources (klystron noise power, gun shot noise power, and shock excitation) are described. (B.G.D.)

46618 (SLAC-PUB-351) THE SLAC ACCELERATOR: FIRST YEAR OF OPERATION. Loew, G. A.; Neal, R. B.; Seppi, E. (Stanford Linear Accelerator Center, Calif.). Sept. 1967. Contract AT(04-3)-515. 22p. (CONF-670930-7). Dep. CFSTI.

From 6th International Conference on High Energy Accelerators, Cambridge, Mass.

The performance achieved at SLAC during the first full year of operation is summarized. Some of the improvement programs now underway are briefly discussed. (B.G.D.)

46619 (UCRL-17604) RESONANT EXTRACTION STUDIES FOR THE BEVATRON. Baconnier, Yves M.; Lambertson, Glen R. (California Univ., Berkeley. Lawrence Radiation Lab.). Sept. 8, 1967. Contract W-7405-eng-48. 8p. (CONF-670930-8). Dep. CFSTI.

From 6th International Conference on High Energy Accelerators, Cambridge, Mass.

An extraction system employing betatron resonance at $\nu_R = 2/3$ was studied for the Bevatron. A single perturbing magnet coincident in azimuth with the first septum will be used. The usable growth rate of the radial amplitude is limited by vertical growth through the coupling at $2\nu_z - \nu_R = 1$. This limitation, together with the general behavior of the beam, was first studied through a linear theory then checked by computer calculations. An energy loss target may be used in combination with the resonance process to aid in jumping the first septum. A trial system is installed in the Bevatron and results of tests will be reported. (auth)

46620 (SLAC-Trans-73) INVESTIGATION INTO THE EFFECTS OF CURRENT PULSE SHORTENING IN MULTISECTION LINEAR ACCELERATORS. Zykov, A. I.; Grishaev, I. A.; Vishnyakov, V. A.; Mocheshnikov, N. I.; Kramskoy, G. D. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Technicheskii Institut). Translated for Stanford Linear Accelerator Center, Calif., from report 276/VE-062. 10p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

The current pulse-shortening phenomenon is linear accelerators at 300 MeV and 2 GeV was studied, and the findings are presented. The character of the destruction of the beam, the amplitude and frequency of oscillations generated by the beam, the change of the amplitude of the hybrid wave upon the displacement of the axis of the accelerating system, and the dependence of the maximum value of the current at which the beam destruction effect is observed on the length of the accelerator are investigated. (W.H.K.)

46621 METHOD OF OBTAINING HIGH NEUTRON FLUX-DENSITIES AND ITS APPLICATIONS. Bueker, H. (Kernforschungsanlage, Juelich, Ger.). Kerntechnik, 9: 409-13(Sept. 1967). (In German).

A method is discussed in which a very intensive high-energy proton beam falls on a heavy metal target thereby producing very high neutron flux-densities. During this process, the target should be operated as a liquid-metal target and consist of lead-

bismuth eutectic. The target itself should be placed into a D_2O-moderator and there produce thermal neutron flux-densities in the range of 10^{16} $cm^{-2}s^{-1}$. The primary proton beam should have an energy of 1 GeV and a current of 65 mA. A new particle-accelerator type was developed to fulfill these specifications. The construction of such a neutron generator would make possible many nuclear and neutron physical experiments and, by the way, permit the production of high enriched nuclear fuel without the need of any other nuclear fuel. It might be that the nuclear fuel gained by this method could be cheaper than that produced by means of the diffusion separation plant. (auth)

46622 10-MeV WAVEGUIDE SYNCHROTRON BASED ON A PLANE-BENT WAVEGUIDE. Vorob'ev, A. A.; Didenko, N. P.; Kaminskii, V. L.; Potekhin, Yu. I. Prib. Tekh. Eksp., No. 3, 20-1(May-June 1967). (In Russian).

The development and test results of a waveguide-type 10-Mev synchrotron are reported. An ordinary, ring-shaped rectangular waveguide operating at H_{118} wave mode with a large longitudinal electric component at the middle radius was used as the accelerating system. This system has the following dimensions: r_1 (inside radius), 8.36 cm; r_2 (outside radius), 19 cm; and h, 8.48 cm. The accelerating system, which also serves as a vacuum chamber, was fabricated from porcelain with a layer of silver 25 μ thick on its inside surfaces. The preliminary acceleration of electrons, which were injected at 30 kV, was performed under betatron conditions up to 4.5 MeV. During the action of a h-f oscillator the particles were drawn into the synchrotron condition and were finally accelerated up to an energy of 10 MeV. A magnetron, operating at 10 cm (cw condition) with an output power of 400 W, was used as the h-f oscillator. At pulse condition with a duration of 5 μsec and an off-duty factor of 4, the magnetron has an output power of 1 kW. The selected parameters of the accelerating system and the output power of the magnetron provide the transfer of the majority of electrons from the betatron to the synchrotron condition. The electromagnet of the system is supplied with a voltage of 125 V, and the capacity of the condenser battery is 150 μF. The accelerator was tested under betatron and synchrotron conditions. The emission was detected by a Geiger–Mueller control counter, an oscilloscope, a photomultiplier and a roentgenometer. The transfer from the betatron to the synchrotron condition does not require any additional devices. The synchrotron acceleration was stable. (auth)

46623 CALIBRATION OF MAXIMUM ENERGIES OF ELECTRON ACCELERATOR BREMSSTRAHLUNG BY MEANS OF PHOTOPROTON SPECTROMETER. Denisov, V. P.; Kul'chitskii, L. A. (Leningrad Inst. of Physics and Tech.). Prib. Tekh. Eksp., No. 3, 25-7(May-June 1967). (In Russian).

A method is given for calibrating the maximum energy scale $E_{\gamma m}$ of bremsstrahlung from an electron accelerator at energies exceeding the threshold of (γ,n) and (γ,p) reactions by measuring spectra of photoprotons from ^{16}O. The method can be used efficiently during calibration at a range of $E_{\gamma m} \approx 20$ to 30 MeV. (tr-auth)

46624 DEVICE FOR MEASURING PROFILE OF ACCELERATED ELECTRON BEAM. V'yalitsin, V. A.; Prudnikov, I. A.; Ryabukhov, I. R. Prib. Tekh. Eksp., No. 3, 36-8(May-June 1967). (In Russian).

Descriptions are given of a simple device for measuring accelerated electron beams. The performance of the device is based on the evaluation of the secondary electron emission from fine metallic foil surfaces during interactions by high-energy electron beams. Brief data are included on the design, performance, and experimental measurements of the cross sections of accelerated electron beams in linear accelerators. (tr-auth)

46625 DETERMINATION OF ACCELERATOR BEAM RADIAL–ANGULAR CHARACTERISTICS. Dem'yanenko, G. K.; Ryabka, P. M. (Inst. of Physics and Tech., Kharkov). Prib. Tekh. Eksp., No. 3, 38-40(May-June 1967). (In Russian).

Experimental data are given for determining high-energy electron emittance by means of electric separation of heavy elements. The current density and angular distribution are measured for 100-Mev electrons with ~1.5 μA mean current. (tr-auth)

46626 VHF WAVEGUIDE STRUCTURE OF 30-MeV MICROTRON. Matora, I. M.; Khar'yuzov, R. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 3, 28-32(May-June 1967). (In Russian).

The design and performance of a waveguide track in a 30-MeV microtron with two ferrite circulators which simplify the operation of the accelerator and stabilize its performance are described. (tr-auth)

46627 COUPLED RESONATOR MODEL FOR STANDING WAVE ACCELERATOR TANKS. Nagle, D. E.; Knapp, E. A.; Knapp, B. C. (Los Alamos Scientific Lab., N. Mex.). Rev. Sci. Instrum., 38: 1583-7(Nov. 1967).

The behavior of standing wave accelerator tanks, made up of chains of resonant cavities, is investigated using a coupled resonator model. This model gives accurate predictions of the behavior of such a cavity chain, including tolerances to errors in manufacture, cavity feed distributions, and transient response. The parameters necessary in the theory, the cavity couplings, Q's, and frequencies, may easily be determined by experiment. Extension of the simple chain to a more complex chain with double periodicity and second nearest neighbor coupling is demonstrated. Advantages of operating such accelerators in the $\pi/2$ mode are shown. (auth)

46628 DETERMINATION OF THE PHASE VOLUME OF A STORAGE RING OR A CYCLIC ACCELERATOR BY INJECTION OF PARTICLES THROUGH FOILS. Kheifets, M. I. Zh. Tekh. Fiz., 37: 1068-73(June 1967). (In Russian).

A method for measuring the acceptance phase volume of a weak focusing cyclic charged particle device (accelerator or storage ring) is described. The method is based on the fact that a uniform charged particle beam, after traversing a thin foil and suffering therein multiple small angle scattering, has an angular spread described by a known distribution, which is determined by the characteristics of the particles and the foil. If a uniform beam is scattered by a foil at a known distance from the inflector, the particles will fill a calculable phase volume at the entrance to the inflector, and the fraction of the particles captured into orbit will be determined by the overlap of this phase volume with the acceptance phase volume of the machine. This overlap can be altered by the use of different foils, and by measuring the fraction of the particles that are captured when different foils are used one can determine the acceptance phase volume. The formulas necessary for the application of this method in the case when the particles are electrons and the angular distribution after scattering in the foil is Gaussian are derived. (ATD)

46629 SAND AS A SIDE SHIELD FOR 30 GeV PROTONS STOPPING IN THE BROOKHAVEN AGS. Casey, W. R.; Distenfeld, C. H.; Levine, G. S.; Moore, W. H.; Smith, L. W. (Brookhaven National Lab., Upton, N. Y.). Nucl. Instrum. Methods, 55: 253-68(Oct. 1967).

A description of an extensive measurements program of the shielding properties of the Brookhaven AGS earth shield is given. It is concluded that the secondary radiations from an internal target are inversely dependent on the square of the distance from the target and the square of the angle to the primary beam after a constant background has been subtracted; that the transverse attenuation of the particle populations in the shield has an exponential decay constant of 83 g/cm^2, with some evidence of a weakly interacting tail after 20 ft. (auth)

46630 ACCELERATING SYSTEMS WITH RING-RESONATOR CONFIGURATION. Speciale, R. A. (Philips Cyclotron Development Dept., Eindhoven, Netherlands). Nucl. Instrum. Methods, 55: 205-37(Oct. 1967).

A short analysis is given of a new configuration for multigap accelerating systems in circular accelerators. The new accelerating systems have the form of periodic ring-resonators and are excited by an unreflected wave travelling around them. These systems include either a single ring of two mutually coupled, concentric rings. Two forms are considered, either with electrodes or with wave-guide sections as the basic accelerating elements. Essential advantages are the large reduction of the number of internal particle revolutions, obtained at practical voltage levels, and the possibility of accelerating and extracting very intense beam currents. Technical advantages are also provided by the elimination of phase servocontrols and by the large reduction of the necessary tuning range in variable energy machines. Further the fundamental principles of ring-resonator theory are reviewed and results of model measurements are described. (auth)

46631 STORAGE RINGS FOR π + p, ETC., SCATTERING. Csonka, P. L. (CERN, Geneva). Phys. Lett., 25B: 423-6(Oct. 2, 1967).

It is suggested that storage rings can be used to perform high c.m.s. energy scattering experiments with unstable hadrons. (auth)

46632 SECONDARY EMISSION MONITOR FOR ELECTRON BEAMS OF HIGH ENERGY AND INTENSITY. Balsamo, E. P.; Guaraldo, C.; Scrimaglio, R. (CNEN, Rome). Nucl. Instrum. Methods, 55: 339-43(Oct. 1967).

A secondary emission device is described. It is able to detect position and profile of an electron beam of high intensity and energy in its transport magnetic channel. Prototype characteristics with associated electronic circuits for signal pick-up and experimental results obtained with the 400 MeV electron and positron

linac of the Laboratori Nazionali di Frascati del CNEN (LNF) are also reported. Experimental results at a primary's energy of 400 MeV are compared with a theoretical calculation based on the Moeller cross-section for the electron-electron scattering, keeping into account, at the thickness involved in the device, other contributions like those from electromagnetic showers and tertiary electrons. (auth)

46633 0.5-MV, 100 μA VAN DE GRAAFF TYPE ION ACCELERATOR: DESIGN AND INVESTIGATION OF THE SYSTEM. Liwo, Jan. Danzig, Danzig Polytechnic Inst., 1965. (In Polish). Thesis.

The design of an electrostatic accelerator and investigation of a constructed unit are discussed. The component parts of the accelerator are described followed by measurements aimed at evaluating the results obtained. A brief characterization of the voltage measurement methods used in electrostatic accelerators and a description of the construction of a meter built in the course of the project are included. The problem of its standardization is discussed more extensively. Voltage regulation and stabilization in electrostatic accelerators are also discussed. Following a description of the stabilization system ultimately produced, the measurements characterizing the quality of stabilization and furnishing the basis for defining the optimum operating parameters are given. (JPRS)

46634 A CYCLOTRON FOR MEDICAL AND BIOLOGICAL INVESTIGATION. I. THE SIGNIFICANCE OF A CYCLOTRON FOR NUCLEAR MEDICINE AND NUCLEAR BIOLOGY. Lorenz, W. J.; Scheer, K. E.; Lindner, H. W.; Chaudhri, M. A. (Deutsche Krebsforschungszentrums, Heidelberg. AEG, Frankfurt am Main). Atompraxis, 13: 251-4(June 1967). (In German).

The cyclotron is a very suitable instrument for the production of shortlived radionuclides and neutrons of high energy. The use of short-lived radioisotopes in the field of nuclear medicine and nuclear biology permits extensive investigations with incorporated γ sources in humans and other biological objects. These investigations are of high interest for organic and functional diagnosis, tumor diagnosis and metabolic studies. Activation analyses, radiobiological and dosimetric studies can be carried out using neutrons. For medical and biological purposes, a small isochronous cyclotron (E_p = 20 MeV, E_d = 10 MeV, $E_{3\alpha}$ = 27 MeV, $E_{4\alpha}$ = 20 MeV) is suggested, its significance for nuclear medicine and nuclear biology being discussed. (auth)

46635 IMPROVEMENTS IN OR RELATING TO A METHOD OF CONTROLLING THE DEFLECTION OF A CHARGED PARTICLE BEAM AND APPARATUS THEREFOR. Blundell, Gordon Roy; Maycock, Alan George; McGinty, Gordon Kenneth (to Mullard Ltd.). British Patent 1,084,582. Sept. 27, 1967. Filed Apr. 13, 1965.

An apparatus for pulsing a charged particle beam is described. The apparatus comprises of a method for directing a beam towards an aperture in a shield, a method for setting up a beam deflection field, whereby, at a given energy the beam is directed through the aperture, and the associated pulse electronic circuitry. (B.G.D.)

46636 IMPROVEMENTS IN OR RELATING TO CIRCUIT ARRANGEMENTS FOR GENERATING ELECTRICAL PULSES. Blundell, Gordon Roy; Maycock, Alan George; McGinty, Gordon Kenneth (to Mullard Ltd.). British Patent 1,084,583. Sept. 27, 1967. Filed Apr. 13, 1965.

Design of an electric pulse generator in the nanosecond range is presented. Use of the pulser for controlling the deflection of a charged-particle beam is described. The whole apparatus comprising the charged-particle source deflector system, pulse generators, apertured plate, and a transmitted-beam collector may be used as an infinitely-variable, contactless, high-power switch. (W.H.K.)

46637 FOCUSING OF CHARGED PARTICLES. VOLUME 1. Septier, Albert (ed.). New York and London, Academic Press, 1967. 518p. $19.00; 152s.

The theoretical and experimental aspects of the problems involved with focusing, directing, and obtaining high resolution beams of charged particles are discussed. Methods for calculating and measuring electric and magnetic fields and particle trajectories are considered. (B.G.D.)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 45447, 45448, 46396, and 46659.

46638 (AERE-M-1911) MULTIPLE ELASTIC SCATTERING OF THERMAL NEUTRONS BY POLYCRYSTALLINE LEAD. Wignall, G. D. (Atomic Energy Research Establishment, Harwell (England)). June 1967. 5p. Dep. CFSTI. UK 1s. 9d.

A series of experiments was conducted on polycrystalline solid lead and the results were compared with theory. The measurements were made on the cold neutron apparatus at the Dido reactor, with neutrons of 4.11 Å wavelength provided by a multislot rotor rotating at 471 rps. The scattered neutrons were detected in BF_3 detectors arranged around the specimen, and the energy analysis was made by time-of-flight methods. The results were corrected for random background, scattering by the container, and for detector variation with neutron energy. It was possible to achieve appreciable multiple elastic scattering levels which were clearly separable from primary and inelastic scattering processes. The importance of measurements with a true polycrystal was demonstrated. (UK)

46639 (BNL-11680) TIME-DEPENDENT NEUTRON THERMALIZATION IN FINITE MEDIA. Dorning, John J. (Brookhaven National Lab., Upton, N. Y.). Mar. 1967. 208p. Dep. CFSTI.

Thesis. Submitted to Columbia Univ., New York.

An investigation is made of the time-dependent behavior of the thermal neutron flux following the introduction of a burst of neutrons into a finite moderating medium. A simple isotropic one-term degenerate scattering kernel is assumed, and the resulting transport operator is examined in detail. The integral form of the space-, energy-, and time-dependent transport equation in slab and spherical geometries is utilized in proving four theorems which determine the nature of the time decay constants as a function of system size. The theorems are then verified by actual calculation of the decay constants. Estimates of the energy, angle, and spatial dependence of the solutions are also obtained. The basic principles of slow-neutron scattering theory are reviewed, and modern scattering models for light water are discussed. The discrete-ordinates method for solution of the neutron transport equation is then described. Following this, the results of fundamental mode decay constant calculations for spherical geometries using realistic H_2O scattering models are reported and compared with experiment. The agreement is found to be quite good. The computed energy spectra and angular distributions of the fundamental-mode neutron fluxes are discussed, and physical interpretations of their behavior are given. The effects of chemical binding in neutron thermalization are shown to be significant by comparison of decay-constant calculations based on a model which neglects chemical binding with those based on models which include this effect (and yield results in good agreement with experiment). Conclusions are stated and possible extensions of the work are suggested. (auth)

46640 (BNL-50059) LOOKING AT MATTER WITH PARTICLES. Brookhaven Lecture Series Number 66. Palevsky, Harry (Brookhaven National Lab., Upton, N. Y.). May 24, 1967. 13p. Dep. CFSTI.

The lecture is begun with a few remarks on measurement methods in physics. X-ray diffraction is discussed briefly, and the use of slow neutrons to study the nucleus, atomic magnetism, and thermal lattice vibrations is considered in detail. The cold neutron facility of the Brookhaven Graphite Reactor is described. Some results are given from investigations of various aspects of the dynamics of solids and liquids, covering Al, V, water vapor, NH_4Br, azoxyanisole, and He II (rotons). Van Hove's theory of neutron scattering from liquids is considered in detail. Finally, the work at the Cosmotron on the use of high-energy protons to study the nucleus is described briefly. (D.L.C.)

46641 (INR-805/XXI/TH) TIME-DEPENDENT NEUTRON TRANSPORT WITH ELASTIC SCATTERING. Borysiewicz, M.; Mika, J. (Institute of Nuclear Research, Warsaw (Poland)). 1967. 16p. Dep.

The linear integro-differential neutron transport equation for a finite homogeneous body surrounded by a vacuum is considered. The scattering kernel includes the term describing the elastic scattering in isotropic approximation. The spectral properties of the corresponding operator are found, and the initial value problem is solved. (auth)

46642 (JAERI-1134) RICM: AN IBM-7090 CODE OF RESONANCE INTEGRAL CALCULATION FOR MULTI-REGION LATTICE. Mizuta, Hiroshi, Aoyama, Koichi; Fukai, Yuzo (Japan Atomic Energy Research Inst., Tokyo). May 1967. 14p. Dep.

The resonance absorption integral of a resonant isotope in a multi-region (≤5 regions) lattice is calculated by an IBM-7090 code, RICM. The lattice configurations considered are a slab lattice, an actual square or hexagonal lattice, and an approximated cylindricalized lattice with the isotropic or perfect reflecting boundary condition. Cases of an isolated rod or plate and a homogeneous system can be also calculated. Slowing down of neutrons by each isotope in each region is treated either by exact numerical integration of the slowing down equation or by the narrow- or wide-resonance approximations. The RICM code consists of three programs: MAIN; LTE; and FFCP-S, -RN, or -C. LTE calculates values of the Doppler functions for resolved and unresolved level regions and prepares a library tape for the MAIN. FFCP-C, -RN, and -S calculate collision probabilities in the cylindrical and slab lattices, respectively, and produce an input card deck for the MAIN. Using the library tape and the probability card deck, the MAIN code calculates the resonance absorption integral of the resonant isotope in each region. (auth)

46643 (ORNL-4134) NEUTRON PHYSICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING MAY 31, 1967. (Oak Ridge National Lab., Tenn.). Aug. 1967. Contract W-7405-eng-26. 150p. Dep. CFSTI.

URANIUM-233, URANIUM-235—neutron capture and fission cross sections at 0.4 to 30 eV, least squares analysis using multilevel formalism

ALUMINUM-27, CARBON-12, COBALT-59, MAGNESIUM-24, SILICON-28, SULFUR-32—neutron differential elastic and inelastic scattering cross sections at 7.6 MeV, angular distribution of, (E)

YTTRIUM—neutron differential elastic scattering cross section at 7.6 MeV, (E)

IRON-56—neutron differential elastic and inelastic scattering cross sections at 4.5 to 7.6 MeV, angular distributions of, (E)

CARBON—neutron differential inelastic scattering cross section at 4.5, 5.0, and 5.6 MeV, (E)

ALUMINUM, CALCIUM, COBALT, SILICON, SODIUM, VANADIUM, YTTRIUM—neutron differential inelastic scattering cross section at 5 MeV, (E)

NEUTRONS—scattering of, correction of time-of-flight data for multiple, (T)

NICKEL-58, NICKEL-60—deuteron reactions (d,n) at 5 MeV, differential cross sections and neutron time-of-flight spectra for, (E)

CHROMIUM-53, COPPER-65, IRON-58, MANGANESE-55, VANADIUM-51—proton reactions (p,n) with, neutron time-of-flight spectra from, (E)

COBALT-59—proton reactions (p,n) at 4.4 MeV, neutron time-of-flight spectra from, (E)

MOLYBDENUM-96—proton reactions (p,n) at 5.5 MeV, neutron time-of-flight spectra from, (E)

COBALT-59—proton reactions (p,n) at 4.3 to 6.0 MeV, gamma spectra from, (E)

MOLYBDENUM-92, MOLYBDENUM-94, MOLYBDENUM-96—proton reactions (p,n) with, gamma spectra from, (E)

TECHNETIUM-92—energy-level transitions from molybdenum-92 (p,n) reactions, (E)

TECHNETIUM-94—energy levels of isomeric, from molybdenum-94 (p,n) reactions, (E)

TECHNETIUM-96—energy-level transitions from molybdenum-96 (p,n) reactions, (E)

BERYLLIUM-9—alpha reactions (α,n) at 6 to 10 MeV, neutron angular distributions for, (E)

NEUTRON SOURCES—neutron spectra from americium-beryllium, plutonium-beryllium, and polonium-beryllium, measurement using NE-213 scintillator, (E)

LINEAR ACCELERATORS—status of ORNL electron

CRITICALITY STUDIES—critical mass and volume of reflected and unreflected paraffin-moderated uranium-tetrafluoride, (E)

NEUTRONS, PROMPT—decay constants in reflected and unreflected paraffin-moderated uranium-tetrafluoride assemblies, (E)

URANIUM FLUORIDE UF_4—criticality studies on reflected and unreflected paraffin-moderated assemblies of, (E)

REACTORS, THERMAL—criticality calculations for, using slightly enriched uranium
CRITICALITY STUDIES—critical mass of polyethylene-moderated and unmoderated enriched-uranium assemblies, (E)
URANIUM—critical mass of polyethylene-moderated and unmoderated assemblies of enriched, (E)
URANIUM-235—critical mass of polyethylene-moderated and unmoderated assemblies of, (E)
CRITICAL ASSEMBLIES—critical mass of polyethylene-moderated and unmoderated enriched-uranium, (E)
REACTORS RESEARCH—criticality experiments with Aberdeen Pulse Reactor, at low power and with superprompt criticality
REACTIVITY—calculation for reactor lattice cells, computer program for
REACTORS—neutron multiplication rates in lattice cell, computer program for calculating
CRITICAL ASSEMBLIES—neutron kinetic equations for coupled, computer programs for solving
ORNL FAST BURST REACTOR—kinetics of, in pulsed operation
ETHYLENE POLYMERS, LEAD—neutron energy distribution from slab shields of, angle-dependent fast, (E/T)
SHIELDING—neutron energy distributions from slab shields of lead and polyethylene, angle-dependent fast, (E/T)
SHIELDING—calculations using discrete ordinates method
GAMMA RADIATION, NEUTRONS—shielding calculations using discrete ordinates method, computer programs for
CHARGED PARTICLES—energy losses in materials, computer program for calculating
RADIATION DETECTORS, SEMICONDUCTOR (SILICON)—charged-particle energy losses in, calculations using ELSA computer program, (T)
ALUMINUM-27, BERYLLIUM-9, INDIUM-115, IRON-56, LEAD-208, NITROGEN-14, TANTALUM-181—proton reactions (p,n) at 15 and 18 MeV, neutron yields from, (E)
BISMUTH-209—proton reactions at 61 MeV, differential cross sections for
IRON-54—proton reactions (p,α), (p,d), (p,He-3), and (p,t) at 61 MeV, differential cross sections for, (E)
BISMUTH-209, IRON-54—proton differential scattering cross section at 61 MeV, (E)
IRON—meson (μ) penetration in, at 500 MeV/c, (T)
LINEAR ACCELERATORS—shielding calculations for 400-MeV electron, (T)
SHIELDING—calculations for 400-MeV electron linear accelerator, (T)
MOON—neutron reactions in surface from cosmic-ray bombardment, gamma spectra from, (T)
GAMMA RADIATION—spectra from neutron reactions and scattering in lunar surface, (T)
NEUTRONS, THERMAL—production by proton reactions with lead and depleted uranium at 540 MeV in thick targets, (T)
LEAD, URANIUM—proton reactions at 540 MeV in thick targets, thermal neutron production by, (T)
BROMINE, SILVER—meson (π^-) reactions at 1.55 GeV, meson (π^+) and proton production by, (E)
PROTONS, MESONS (π^+)—production in meson (π^-) reactions with bromine and silver at 1.55 GeV, (E)
COPPER—proton reactions at 0.66 GeV, proton angular distributions and spectra from, (T)
PLATINUM—proton reactions at 2.9 GeV, proton angular distributions and spectra from, (T)
RADIATION DETECTORS, FISSION CHAMBER—neutron response function for polyethylene-moderated, fast. (T)
NEUTRONS, FAST—detection using polyethylene-moderated fission chambers, response functions for, (T)
GAMMA RADIATION—detection using Compton diode detector, response function for, (T)
RADIATION DETECTORS, SEMICONDUCTOR—gamma response function for Compton diode, (T)
COMPUTERS—use on-line of PDP-7, for data acquisition and reduction; converter interface for PDP-7, analog-to-digital
DATA ACQUISITION SYSTEMS—development using on-line PDP-7 computer
NEUTRON SPECTROMETERS—response of boron-filtered, computer program for simulating
RADIATION DETECTORS, SCINTILLATION—calibration of proton-recoil NE-213 organic liquid, for fast neutrons
NEUTRON SPECTROMETERS—calibration of proton-recoil organic liquid scintillation, for fast neutrons
PHOSPHORS—response of organic, to alpha particles, electrons, and protons
ALPHA PARTICLES, ELECTRONS, PROTONS—detection using organic scintillators, response functions for
PREAMPLIFIERS—design of vacuum-hardened charge-sensitive
NEUTRON CROSS SECTIONS—calculation of group-averaged, computer program for
INFORMATION CENTERS—operations summary for Radiation Shielding
NEUTRON CROSS SECTIONS—calculation of group-averaged, for multigroup adjoint discrete ordinates calculations
AIR—neutron transport in, time-dependent, (T)
NEUTRONS—transport in air, time-dependent, (T)
SYSTEMS FOR NUCLEAR AUXILIARY POWER (SNAP)—response functions for core-mapping collimator
TOWER SHIELDING FACILITY—reactor power distribution in SNAP experiments
SYSTEMS FOR NUCLEAR AUXILIARY POWER (SNAP)—reactor power distribution in Tower Shielding Facility
GAMMA RADIATION—spectra from neutron capture, method for calculating
NEUTRONS—capture by nuclei, method for calculating gamma spectra from
TISSUES—neutron flux-to-dose conversion factors for
NEUTRONS—doses in tissues, flux-to-dose conversion factors for
RADIOACTIVE MATERIALS—shipping of, cask shielding requirements for
SHIPPING—cask shielding requirements for radioactive materials
LITHIUM-6, LITHIUM-7—neutron cross sections for, multigroup fast, (T)
LITHIUM HYDRIDES—neutron dose distribution from point isotropic fission source in, fast, (T)
NEUTRONS, FAST—dose distribution from point isotropic fission source in lithium hydride, (T)
GAMMA RADIATION—spectra from thermal neutron capture by aluminum and iron, (E/T)
ALUMINUM, IRON—neutron capture by, gamma spectra from thermal, (E/T)
GAMMA SPECTROMETERS—response functions of sodium-iodide scintillation, for neutron-capture gamma radiation
SHIELDING MATERIALS, CONCRETES—neutron capture by, gamma spectra from thermal, (E)
NEUTRONS—spectra from reflection between parallel concrete slabs, (T)
CONCRETES—neutron spectra from reflection between parallel slabs of, (T)
NEUTRON CROSS SECTIONS—evaluation of minima in total, method of
TOWER SHIELDING FACILITY—shielding calculations for SNAP reactor, using discrete ordinates method
SYSTEMS FOR NUCLEAR AUXILIARY POWER (SNAP)—shielding calculations for Tower Shielding Facility (D.C.W.)

46644 (WANL-TME-1640) INELASTIC THERMAL NEUTRON SCATTERING. Johnston, A. S. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). July 1967. Subcontract NP-1. 51p. Dep. CFSTI.

A modern derivation of inelastic neutron scattering cross sections for polycrystalline solids in the harmonic approximation has been collected and is presented. The detailed balance condition is derived. The usefulness of the scattering law is discussed. Approximations made in the calculation of thermal kernels for neutron design are discussed. Current work on kernels is reviewed. Investigation of the variation of several parameters on the Debye model, especially the effective temperature for use in a gas model kernel calculation, is given. (auth)

46645 (BNL-tr-154) TOWARD THE THEORY OF ATTENUATION OF THE DENSITY OF NEUTRONS FROM A PULSED SOURCE IN LIMITED VOLUMES OF THE MODERATOR. Kazarnovskii, M. V.; Maiorov, L. V.; Yudkevich, M. S. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). Translated by Stephen J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from a Russian report. 20p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

The time dependence of the neutron distribution from a pulsed source in limited volumes of moderator is developed enabling one to calculate this dependence for real moderators. The estimations of the effect of the nonexponential attenuation show that the main quatitative conclusions obtained by Corngold and Durgun retain their validity under real conditions within the framework of the simplified model and prove the applicability of the approximation of Ghatak's "truncated" equation for not too large intervals of time. (S.F.L.)

46646 THE INITIAL-VALUE TRANSPORT PROBLEM FOR MONOENERGETIC NEUTRONS IN AN INFINITE SLAB WITH DELAYED NEUTRON PRODUCTION. Kaper, Hans G. (Stanford Univ., Calif.). J. Math. Anal. Appl., 19: 207-30 (Aug. 1967).

The initial-value problem for neutron transport in a multiplying slab is solved in terms of a semi-group of transformations. A representation of the semi-group in terms of the eigenfunctions and resolvent of the associated transport operator is given. (D.C.W.)

46647 INELASTIC NEUTRON CROSS SECTION FOR A MAGNETIC IMPURITY IN A HEISENBERG FERROMAGNET. Lovesey, S. W. (Oxford Univ.). Proc. Phys. Soc. (London), 91: 658-70(July 1967).

The inelastic neutron cross section is calculated for a Heisenberg ferromagnet containing either a ferromagnetically or an antiferromagnetically coupled impurity. This is achieved by constructing the appropriate total spin operator Green functions from their equations of motion and using a decoupling scheme that renders the analysis equivalent to employing the linear spin-wave approximation. It is shown that the cross section as a function of neutron energy change exhibits peaks when the condition for an impurity mode is satisfied. The cross sections contain both diffuse and coherent terms. The former are of direct experimental interest and are discussed in detail for both types of impurity. (auth) (UK)

46648 INVESTIGATION OF MAGNON DISPERSION RELATIONS AND NEUTRON SCATTERING CROSS SECTIONS WITH SPECIAL ATTENTION TO ANISOTROPY EFFECTS. Lindgard, P. A. (Danish Atomic Energy Commission, Risoe). J. Phys. Chem. Solids, 28: 1357-70(Aug. 1967).

A general bilinear two-Bose Hamiltonian is diagonalized and the results used in a discussion of non-interacting spin waves in a two-sub-lattice ferromagnet having no negligible anisotropy in the spin interaction. Model-independent functions suitable for the analysis of experimental dispersion curves are suggested. The magnon cross section for unpolarized neutrons is calculated and is shown to be dependent on the anisotropy in the spin interaction. Thus in principle it allows the detection of anisotropy in the exchange interaction. Some remarks are made concerning antiferromagnetic and plane-helical structure. A numerical calculation is performed for terbium on the basis of the Kaplan–Lyons Hamiltonian with added crystalline anisotropy. The non-isotropic exchange part is shown to have a small effect on the dispersion curves, and it appears that radical changes of the Ruderman–Kittel-type functions for the exchange interaction are necessary for agreement with experimental dispersion curves. The effect of the anisotropy in the cross section is estimated and shown to be important for small magnon energies. (auth) (UK)

46649 CALCULATION OF THE SPECTRAL NEUTRON DISTRIBUTION BEHIND A CURVED TOTALLY REFLECTING COLLIMATOR SLIT. Binder, K.; Rauch, H. (Oesterreichische Hochschule, Vienna). Atomkernenergie, 12: 337-42(1967). (In German).

In continuation of a previous paper on angular distribution, the calculation of the spectrum of neutrons behind a totally reflecting curved collimator is given. The wavelength distribution for various deflections and the average wavelength spectrum for various collimators is calculated. The percentage of cold neutrons and the average number of reflections is shown. The results can be applied to the construction of collimator systems consisting of totally reflecting collimator slits with various curvatures. Such systems can be used simultaneously for neutron deflection and focusing as well as filtering of slow neutrons. (auth)

46650 CONSTRUCTION OF A PULSED NEUTRON GENERATOR. Bobrowski, Cz.; Massalski, J. (Institut fuer Kerntechnik, Krakow). Isotopenpraxis, 3: 148-50(Apr. 1967). (In German).

A portable probe producing fast neutrons, which can operate both in the pulsed and stationary modes, was constructed. The construction of the neutron tube is described in detail, and the wiring diagram for the pulsed neutron generator is given. The neutron yield in dependence on the deuteron energy was determined. (J.S.R.)

46651 AN EXPERIMENTAL DETERMINATION OF THE NEUTRON AGE TO THE INDIUM RESONANCE ENERGY IN ALUMINUM–WATER MIXTURES. Spencer, Joseph DuPuy. Charolettsville, Va., Univ. of Virginia, 1966. 157p.

Thesis.

The neutron age was measured to the indium resonance energy for light water and three metal-to-water volume ratios (1/4, 1/2, 2/3) in aluminum-water mixtures. A large plane highly enriched ^{235}U fission plate provided the source of neutrons, and aluminum plates, (0.050'' × 48'' × 48''), were used for the metal. These plates were oriented parallel to the source plane for all of the measurements. The infinite detector plane approach was employed to obtain a distribution equivalent to an infinite plane source. From these data, the ages for the four cases were: M/W = 0, (26.24 ± 0.33 cm^2); M/W = 1/4, (32.28 ± 0.50 cm^2); M/W = 1/2, (39.96 ± 0.50 cm^2); M/W = 2/3, (44.88 ± 0.59 cm^2). These results exhibited reasonable agreement with theoretical calculations; however, they did not illustrate the curvature away from the theoretical distribution at high metal-to-water ratios that was evident in a set of recently reported results. Heterogeneous effects or neutron streaming were examined for the two-thirds metal-to-water ratio by lumping five plates together to approximate a thick plate. The measurements indicated no significant difference from the single plate results for the age and the fourth moment, however, the sixth moment was higher. For these measurements, the presence of small amounts of water among the plates may have been sufficient to destroy the simulation of a thick plate. In addition to the infinite detector plane technique, the age was calculated with a set of geometrical corrections for the finite size fission plate data. The result for pure water was (27.82 ± 0.66 cm^2). This age was approximately 6% above the mean theoretical value (26.0 ± 0.5 cm^2) and the infinite detector plane result, thus indicating a difficulty with these geometrical transformations. (Disser. Abstr.)

46652 RESONANCE ABSORPTION WITH SPATIALLY DEPENDENT ASYMPTOTIC FLUXES. deLoach, Anthony Cortelyou. Columbia, S. C., Univ. of South Carolina, 1966. 82p.

Thesis.

In resonance integral calculations using the collision probability method, a common approximation is made that the source flux in the moderator is spatially constant for all lattice pitches. It was found that under certain circumstances this approximation has a considerable effect on the calculation of the resonance integral. Through the use of an equivalence principle between homogeneous and heterogeneous systems which retains the spatial dependence of the sources, analytical expressions were developed for resonance integrals in both the narrow resonance and narrow resonance-infinite mass absorber approximations. Corrections to the flat flux resonance integrals were formulated as a function of pitch for practical lattices. (Disser. Abstr.)

46653 ENERGY-DEPENDENT NEUTRON TRANSPORT THEORY NEAR A TEMPERATURE DISCONTINUITY. Gritton, Eugene Charles. Los Angeles, Univ. of California, 1966. 162p.

Thesis.

An exact solution of the energy-dependent Boltzmann transport equation in the thermal region near a temperature discontinuity was obtained for a medium which is non-absorbing, infinite in extent and which has a temperature T_1 in one half-space and T_2 in the other half-space. The scattering cross section is assumed energy-independent and the scattering transfer kernel is represented by a degenerate kernel approximation to the heavy gas model. The method of solution is based upon the space-dependent thermalization theory developed by Ferziger and Leonard using the formalism of Case. Numerical calculations of both the scalar neutron flux and total neutron density are included for various temperature ratios and neutron-to-moderator mass ratios. These results are compared with diffusion theory and other approximate methods to assess the accuracy of the approximations. The limitations placed on this theory owing to the use of the heavy gas model are examined. For moderators of interest, temperature ratios of the order of 2 or 3 to 1 represent an upper limit for accurate calculations. Both diffusion theory and transport theory give the same numerical value of the flux at the interface. Away from the interface, a discrepancy between diffusion theory and transport theory becomes apparent. The reason for this is that diffusion theory incorrectly describes the energy mode relaxation lengths thus giving rise to an incorrect spatial dependence. Diffusion theory predicts the diffusion lengths accurately only when the energy exchange between the diffusing neutrons and the moderator material is weak. In addition, diffusion theory is found to become progressively less accurate for the higher energy modes. Thus, as the higher energy modes become more important, such as for a larger neutron-to-moderator mass ratio or for a larger temperature discontinuity, transport theory calculations of the neutron flux must replace the diffusion theory analysis. (Disser. Abstr.)

46654 A STUDY OF THE DIFFUSION OF THERMAL NEUTRONS IN HETEROGENEOUS GRAPHITE–CADMIUM ASSEMBLIES BY THE PULSED NEUTRON SOURCE TECHNIQUE. Mohr, Jacobus G. New York, New York Univ., 1966. 302p.

Thesis.

The diffusion of thermal neutrons in heterogeneous graphite-cadmium assemblies was investigated by the pulsed neutron source technique. The inverse mean lifetime of thermal neutrons was experimentally determined in seven GBF graphite parallel-

epipeds, with geometric bucklings ranging between 0.00492 and 0.0115 cm^{-2}, by measuring the decay in time of the equilibrium thermal neutron field following the injection of a short pulse of fast neutrons into an assembly. The observed values compared well with calculations based upon published values of the diffusion parameters of GBF graphite. Hollow cylindrical cadmium rods, with respective radii 0.64, 0.96, 1.27, 1.91, and 2.58 cm, were fully inserted along the vertical axes of the graphite assemblies, and the decay constants of the heterogeneous assemblies were determined. Several additional arrays of rods were studied in the largest graphite assembly. These arrays consisted of one, two or four rods of the same size, symmetrically located on the circumference of a circle concentric with the vertical axis of the assembly. In some cases, an axial rod was also introduced. The experimentally observed decay constants of the perturbed assemblies were translated into equivalent geometric bucklings, and compared with theoretical predictions. The Nordheim–Scalettar method of treating black absorbers, in the formalism of Sinyutin and Semenov, was found to predict the observed bucklings successfully, provided that a diffusion cooling correction was applied to the boundary condition on the neutron flux at a cadmium–graphite interface, and sufficient allowance was made for the angular dependence of the flux. The validity of some approximations to the exact theory was also investigated. (Disser. Abstr.)

46655 SOME ASPECTS OF NEUTRON TRANSPORT THEORY UNIFICATION. Bullard, Amos Gentry Jr. Raleigh, N. C., North Carolina State Univ., 1967. 217p.

Thesis.

A framework is examined wherein the traditional transport approximations may be derived in a uniform and consistent manner, the new aspects of thermalization can be examined, and the structural relations between slowing and thermalization can be viewed. A by-product of such a unifying system is the identification and evaluation of all assumptions associated with mathematical approximations to the transport equation and the generation of new forms worthy of additional attention. A demonstration of another unification concept is given by the study of the role of Green's functions in the solution of the infinite medium slowing and thermalization problems. The origin of Green's function applications to the solution of the integral equation describing neutron slowing through resonances is cited. The extension of this approach to include its use in the determination of resonance absorption and upscattering effects on thermal neutron spectra is presented. In the general case, the inhomogeneous integral equation describing neutron thermalization from a monoenergetic source, represented as a Dirac delta-function, is shown to be transformed into a set of two coupled homogeneous integral equations. For the special case of thermalization in a homogeneous monatomic hydrogen gas, this set of equations is converted by appropriate operations into a single second-order differential equation with Green's function type boundary conditions characteristic of two-point boundary value problems. The inhomogeneous integral equation describing neutron thermalization is further discussed, and its solution for the Green's function in terms of an expansion in eigenfunctions of the collision operator is investigated. (Disser. Abstr.)

46656 APPROXIMATE SOLUTION TO THE TIME-DEPENDENT MULTIGROUP NEUTRON-DIFFUSION EQUATIONS USING A RESTRICTED VARIATIONAL PRINCIPLE. Robinson, James Conda. Knoxville, Tenn., Univ. of Tennessee, 1966. 115p.

Thesis.

For some reactors now in operation or being considered, it has become apparent that a time-dependent mathematical neutronic model which permits a shift in the neutron energy and/or spatial spectrum is required for the dynamic study of these systems. Models which describe the behavior of the neutrons in space, energy, and time are well-known, e.g., the multigroup neutron diffusion equations, but the solution to the resultant set of coupled nonlinear differential-integral equations must be approximate. The classical approximation is to assume that the neutron energy and spatial spectrums are independent of time. The purpose of this study was to develop an approximate solution for the time-dependent multigroup neutron diffusion equations with temperature-dependent parameters, thereby retaining a mechanism to permit a shift in the spatial or energy neutron spectrum during a transient. The nonlinear equations which describe the neutronic state of the system are linearized in a discrete fashion, i.e., the nuclear parameters are assumed constant over some spatial region and increment in time. As the calculation progresses in time, the nuclear parameters are adjusted as dictated from the neutronic and thermodynamic state of the system. An approximate solution is obtained for the set of linearized neutron diffusion equations by assuming the neutron flux can be represented by linear combination of known spatial modes with time varying coefficients. The equations which determine the time varying coefficients are generated by applying a restricted variational principle. The spatial modes chosen to represent the flux are the Greens Function Modes. The delayed neutron precursors are explicitly taken into account by assigning the precursor equations as equations of constraint to the functional whose Euler equations include the system equations. Upon the application of the variational principle, the adjoint operator and adjoint function flux are introduced into the analysis. The solution to the adjoint equations is as equally difficult as the solution of the diffusion equations; therefore, a modal expansion is assumed for the adjoint flux. With the assumed solution for the forward and adjoint flux, the restricted variational principle leads to a coupled set of linear differential equations which determine the time-varying coefficients appearing in the assumed solutions. The number of such equations, in general, is the product of the number of modes by the number of groups appearing in the multigroup formalism. The number of equations can be reduced by assuming that different energy groups can be described by the same time varying coefficients. To demonstrate the validity of the approximate solution, several transients, which were performed on the TREAT reactor at Argonne National Laboratories, are simulated. The analytical results are presented graphically in the form of power traces which are compared with the experimental power traces. The analytical model is composed of five energy groups, up to three spatial modes, and six delayed neutron groups. The required data to carry out a simulation are the neutron multigroup parameters, delayed neutron fractions, precursor decay constants, and nuclide specifications. From the results, it is concluded that the model is adequate for short-term transients in thermal systems. Recommendations are set forth for useful extensions of the model to other problems of interest in reactor dynamics. (Disser. Abstr.)

46657 IMPROVEMENTS IN OR RELATING TO NEUTRON GENERATORS. Bounden, John Ellery; Large, Leslie Noel (to United Kingdom Atomic Energy Authority). British Patent 1,088,088. Oct. 18, 1967. Filed Mar. 11, 1965.

A design is given for a neutron generator comprising a sealed glass tube in which deuterium and/or tritium ions from a plasma are accelerated to strike a target containing deuterium and/or tritium to produce neutrons by the D–D and/or T–T reaction. An output of 10^{10} neutrons per sec is obtained in either continuous or pulsed operation. (S.F.L.)

46658 IMPROVEMENTS IN AND RELATING TO ION SOURCES. (to Philips Electronic and Associated Industries Ltd.). British Patent 1,083,626. Sept. 20, 1967. Priority date Apr. 17, 1965, Netherlands.

The design of gas-discharge electrodes for high-current ion sources is presented. Specifications for this ion source used in a neutron generator are included. (W.H.K.)

Nuclear Properties and Reactions, A≤ 5

Refer also to abstract 46818.

46659 (CCDN-NW–6) NEWSLETTER NO. 6. (European Nuclear Energy Agency, Paris (France)). Sept. 1967. 32p. Dep.

A compilation of existing data on the $^3He(n,p)T$ and the $^3He(n,d)D$ reaction cross sections and the total and scattering cross sections is presented. It is shown that a proper extrapolation of the thermal (n,p) cross section fits the data above 5 keV. A table of evaluated recommended values of the $^3He(n,p)T$ cross section up to 10 MeV is given. The estimated uncertainties of recommended values are 0.2% (1 eV), 1% (1 keV), 3% (10 keV), and 10% (>100 keV). The $^3He(n,d)D$ cross section is deduced from the inverse reaction, and the proper detailed balance formulas for the differential and total reaction cross sections are discussed. (auth)

46660 (LA-DC–8878) A CALCULATION OF THE $^1H(n,n)$ DIFFERENTIAL CROSS SECTION IN THE ENERGY RANGE 1 TO 20 MeV. Hopkins, John C. (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-36. 10p. (CONF-670629–5). Dep. CFSTI.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia.

The results of a phase-shift calculation of the differential cross section of neutron elastic scattering by hydrogen at 1 to 20 MeV are presented. The phase shifts used are discussed in detail. (D.C.W.)

46661 (ORNL-TM-1914) TWO-PROTON FINAL-STATE INTERACTIONS IN THE REACTIONS ^{3}He(d,t)2p, d(^{3}He,t)2p, ^{3}He(^{3}He,^{4}He)2p, AND p(^{3}He,d)2p. Morton, Bobby Joe (Oak Ridge National Lab., Tenn.). Sept. 1967. Contract W-7405-eng-26. 82p. Dep. CFSTI.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

The energy spectra of the observed particles for the reactions ^{3}He(d, t)2p, D(^{3}He, t)2p, ^{3}He(^{3}He, ^{4}He)2p, and ^{1}H(^{3}He, d)2p were measured at forward angles using the 36-MeV deuteron beam and the 53- and 74-MeV ^{3}He beams from the Oak Ridge Isochronous Cyclotron. Each of the spectra was characterized by a peak in the high-energy region corresponding to the two unobserved protons having a low relative energy. These peaks were attributed to the enhancement of the cross section in this energy region by the final-state interaction of the two protons. The data were analyzed using the final-state interaction theory of Watson and Migdal. This theory gave an adequate representation of the data for the reactions ^{3}He(d, t)2p and ^{3}He(^{3}He, ^{4}He)2p using the known proton–proton interaction. However, for the other reactions, D(^{3}He, t)2p and ^{2}H(^{3}He, d)2p, the observed peaks were much narrower than the theoretical predictions. For the reaction D(^{3}He, t)2p, the narrower peak could be explained by assuming the primary reaction mechanism is a charge-exchange process and calculating this effect using the impulse approximation. (auth)

46662 PHASE-SHIFT ANALYSIS OF CROSS SECTIONS AND POLARIZATION IN ELASTIC PROTON-DEUTERON SCATTERING. Arvieux, J. (Service de Physique Nucleaire a Moyenne Energie, Saclay, France. Institut des Sciences Nucleaires, Grenoble, France). Nucl. Phys., A102: 513-28(1967). (In French).

The most general scattering amplitude matrix for nucleon-deuteron scattering is parametrized in terms of phase-shifts and the channel-spin conservation hypothesis is discussed. These results are applied to a phase-shift analysis of proton-deuteron scattering (cross sections, proton polarization, deuteron vector and tensor polarizations) for energies of protons between 1.5 and 11.5 MeV (corresponding to 3 to 23 MeV deuteron energy in deuteron-proton scattering). Doublet phase shifts are much less sensitive to the analysis than the quartet ones which exhibit a well-established 10% splitting for P- and D-waves. (auth)

46663 MEASUREMENT OF VECTOR AND TENSOR POLARIZATION IN ELASTIC SCATTERING OF 21.7 MeV DEUTERONS BY PROTONS. Arvieux, J.; Beurtey, R.; Goudergues, J.; Mayer, B.; Papineau, A.; Thirion, J. (CEN, Saclay, France). Nucl. Phys., A102: 503-12(1967). (In French).

The vector (t_{11}/i) and tensor (t_{20} and t_{22}) deuteron polarization parameters were measured in elastic scattering of 21.7 MeV deuterons by protons between 34° and 145° in the c.m. system. The parameter t_{11}/i is negative and small ($|t_{11}| < 0.04$) and exhibits a 10° displacement of the maximum of polarization compared to lower energy results. The t_{20} parameter reaches a maximum of -0.09 at $\theta_{c.m.} = 120°$, and t_{22} is smaller ($|t_{22}| \leq 0.06$) and negative in the angular range investigated. (auth)

46664 POLARIZATION IN p-α SCATTERING. Jahns, M. F.; Bernstein, E. M. (Univ. of Texas, Austin). Phys. Rev., 162: 871-8(Oct. 20, 1967).

The polarization of protons elastically scattered from ^{4}He was measured at a total of 11 points including six different angles and four energies between 6 and 11 MeV. Carbon was used as an analyzer. Excellent agreement was obtained between the present results and the measurements of Brown, Haeberli, and Saladin. A phase-shift analysis at 10 MeV provides evidence for small positive split d waves at this energy with the d_δ phase shift 1 to 2 deg larger than the d_δ phase shift. (auth)

46665 UNIQUE DETERMINATION OF THREE PROTON–PROTON SCATTERING PARAMETERS AT 9.69 MeV. Noyes, H. Pierre; Lipinski, H. M. (Stanford Univ., Calif.). Contract AT(04-3)-515. Phys. Rev., 162: 884-9(Oct. 20, 1967). (SLAC-PUB-268).

The well-established fact that the spin-orbit interaction is of short range compared to one-pion-exchange (OPE) interaction causes the phase-shift combination $\Delta_{LS} = (-2\delta_{1,0} - 3\delta_{1,1} + 5\delta_{1,2})/12$ to be small compared to $\Delta_T = 5(2\delta_{1,0} - 3\delta_{1,1} + \delta_{1,2})/12$ at low energy. It is found that this makes it impossible to carry through an unambiguous phase-shift analysis of existing data near 10 MeV for δ_0 and $\delta_{1,1}$, but it also makes it possible to show that the ratio Δ_{LS}/Δ_T must lie between 0.07 and 0.15 at 9.69 MeV. Using this result, one can then uniquely determine δ_0^0, Δ_T, and $\Delta_C = (\delta_{1,0} + 3\delta_{1,1} + 5\delta_{1,2})/9$ and obtain $\delta_0^0 = 55.69° \pm 0.28°$, $\Delta_T = 0.91° \pm 0.28°$, $\Delta_C = -0.020° \pm 0.029°$ with relative correlations (0T) = −0.96, (0C) = 0.47, (TC) = −0.30. The result is stable against variation of Δ_{LS}/Δ_T over the full physically allowable range, against the extrapolation needed to include $[A_{yy}/A_{zx}]$ (90°) at 11.4 MeV in the data set, against vacuum polarization corrections, and against whether or not phases with $J > 2$, $^3F_3$, and (marginally) ϵ_2 are dropped or given their OPE values. The data require $^1D_2$ to be within 30% of the OPE prediction, and the value of Δ_T given above also agrees with this prediction to the same accuracy. This is important as it shows conclusively that p-p differential cross sections below 10 MeV can be analyzed uniquely and stably for only two nuclear parameters (δ_0^0 and Δ_C) by using the OPE prediction multiplied by the Coulomb-barrier penetration factor for all other nuclear scattering parameters. The small value of Δ_C is presumably due to the delicate cancellation between the weakly repulsive OPE central P-wave interaction and the strongly attractive intermediate-range attraction arising from the exchange of two interacting pions in the $I = 0$ π-π S state. A single (model-dependent) parameter measuring the strength of this attraction relative to OPE will account both for this value of Δ_C and for the four values prevfously determined at 3 MeV and below. The value of δ_0^0 again confirms the predicted OPE shape correction in the $^1S_0$ state to modest accuracy and, taken together with results below 3 MeV and near 27 MeV, establishes the existence of the shape correction beyond reasonable doubt. (auth)

46666 ON THE ODD-PARITY STATES IN ^{4}He. Shastry, S.; Rustgi, M. L. (State Univ. of New York, Buffalo). Phys. Lett., 25B: 391-2(Oct. 2, 1967).

Taking one-hole one-particle configurations up to the 2p shell and employing various exchange mixtures the odd-parity states $J = 1^-$ (T = 1) and 0^-, 2^- (T = 0) in ^{4}He were calculated. The ratio of $B(E1')_{1^- \to 0^+}/B(E1)_{1^- \to 0^+}$ is found to be 0.312 for the Serber-Yukawa force, compared to the experimental value 0.5. (auth)

46667 NUCLEAR STRUCTURE EFFECTS IN (π^+,2p) REACTIONS. Favier, J.; Bressani, T.; Charpak, G.; Massonet, L.; Meyerhof, W. E.; Zupancic, C. (CERN, Geneva). Phys. Lett., 25B: 409-11(Oct. 2, 1967).

Pions of 80 MeV from the CERN Synchrocyclotron were used to investigate (π^+,2p) reactions on 16 target nuclei. Excitation spectra of the residual nuclei are presented for targets of ^{12}C, ^{14}N, and ^{16}O and are compared with predictions of Kopaleishvili et al. It appears that at low residual excitation energies ($\leq$ 20 MeV) nuclear structure effects play an important role in (π^+,2p) reactions. (auth)

46668 AN INVESTIGATION OF THE THREE-BODY REACTION ^{3}He(^{3}He,2p)^{4}He. Bacher, Andrew Dow. Pasadena, Calif., California Inst. of Tech., 1967. 199p.

Thesis.

Reactions produced by the ^{3}He bombardment of ^{3}He were investigated for bombarding energies from 1 to 20 MeV using a tandem Van de Graaff accelerator. Proton spectra from the three-body reaction ^{3}He(^{3}He,2p)^{4}He were measured with a counter telescope at 13 angles for 9 bombarding energies between 3 and 18 MeV. The results are compared with a model for the reaction which includes a strong p-^{4}He final-state interaction. Alpha-particle spectra were obtained at 12 and 18 MeV for forward angles with a magnetic spectrometer. These spectra indicate a strongly forward-peaked mechanism involving the $^1S_0$ p-p interaction in addition to the p-^{4}He interaction. Measurements of p-^{4}He and p-p coincidence spectra at 10 MeV confirm these features of the reaction mechanism. Deuteron spectra from the reaction ^{3}He(^{3}He,d)p^{3}He were measured at 18 MeV. A triton spectrum from the reaction ^{3}He(^{3}He,t)3p at 20 MeV and 4° is interpreted in terms of a sequential decay through an excited state of the alpha particle at 20.0 MeV. No effects are observed which would indicate an interaction in the residual (3p) system. Below 3 MeV the ^{3}He(^{3}He,2p)^{4}He reaction mechanism is observed to be changing, and further measurements are suggested in view of the importance of this reaction in stellar interiors. (Disser. Abstr.)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 45085, 46392, 46477, 46667, 46696, 46723, 46807, and 46825.

46669 (UCRL-17732) THE (^{3}He,p) AND (α,d), TWO-NUCLEON STRIPPING REACTIONS ON ^{12}C AND ^{16}O: MECHANISM AND NUCLEAR SPECTROSCOPY. Mangelson, Nolan Farrin (California Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1967. Contract W-7405-eng-48. 171p. Dep. CFSTI.

Thesis.

Spectra and angular distributions were obtained for the reactions and conditions listed: $^{12}C(^3He,p)^{14}N$ at $E(^3He) = 20.1$ MeV, from $\theta_{lab} = 8$ to 170° for ^{14}N excited states below 13-MeV excitation; $^{12}C(^3He,^3He)^{12}C$ at $E(^3He) = 20.1$ MeV, from $\theta_{lab} = 8.5$ to 62.5° for the ground state and 4.433-MeV state of ^{12}C; $^{16}O(^3He,p)^{18}F$ at $E(^3He) = 19.8$ MeV, from $\theta_{lab} = 9$ to 170° for ^{18}F excited states below 11.3-MeV excitation; $^{16}O(\alpha,d)^{18}F$ at $E(\alpha) = 40.3$ MeV, from $\theta_{lab} = 8$ to 80° for ^{18}F excited states below 12.7-MeV excitation. Distorted-wave calculations of angular distributions and relative cross sections for the two (^{3}He,p) reactions were compared to experimental values. Agreement was found when a spin-independent interaction potential was used. Nuclear wave functions used in the calculations were discussed. Spectroscopic and configuration assignments were made or confirmed on the basis of excitation energy, angular distribution, comparison of (α,d) and (^{3}He,p) results, relative total cross section, and comparison of experimental quantities to the DW calculations. The following assignments were made for ^{14}N. A spin and parity assignment of 2^- and a tentative assignment of 4^+ were made for the 9.388- and 10.85-MeV, T = 0 levels respectively. Suggested configurations were made for the 8.979-, 10.213-, and 10.85-MeV levels. Configurations and J^π values of 3^+ and 4^+ were suggested for ^{18}F levels at 3.358 and 5.594 MeV, respectively. Configurations and $J^\pi T$ values were confirmed for some levels, and T = 0 assignments were made for a large number of levels. A new ^{18}F level at an excitation energy of 8.596 MeV was identified. (auth)

46670 (UCRL-17783) MASS AND SPECTROSCOPIC MEASUREMENTS OF COMPLETE ISOSPIN QUARTETS IN THE LIGHT NUCLEI. Butler, Gilbert W. (California Univ., Berkeley. Lawrence Radiation Lab.). Aug. 30, 1967. Contract W-7405-eng-48. 87p. Dep. CFSTI.

Thesis.

The mass 13, 21, and 37 isospin T = 3/2 quarters were completed through a series of nuclear reaction investigations. A standard particle identifier was used to measure the mass of the $T_z = -3/2$ nuclide ^{13}O via the $^{16}O(^3He,^6He)^{13}O$ reaction at 65 MeV. An improved particle-identification system, which employed two transmission (dE/dx) and one stopping (E) detector, was used to determine the masses of the $T_z = -3/2$ nuclei ^{21}Mg and ^{37}Ca via the $^{24}Mg(^3He,^6He)^{21}Mg$ and $^{40}Ca(^3He,^6He)^{37}Ca$ reactions at 56 MeV. The first three T = 3/2 levels in ^{21}Ne were established by a simultaneous study of the $^{22}Ne(d,t)^{21}Ne$ and $^{22}Ne(d,^3He)^{21}F$ reactions at 39.6 MeV, while the $^{23}Na(p,t)^{21}Na$ reaction at 42 MeV was utilized to observe the lowest T = 3/2 level in ^{21}Na. Excitation energies of the lowest T = 3/2 levels in ^{37}K and ^{37}Ar were determined via the $^{39}K(p,t)^{37}K$ and $^{39}K(p,^3He)^{37}Ar$ reactions induced by 45-MeV protons. Data from the complete isospin quartets were used to test the isobaric multiplet mass equation and the various predictions of masses of neutron-deficient nuclei. Preliminary studies of the angular distributions of the $^{16}O(^3He,^6He)^{13}O$, $^{16}O(^3He,^6Li)^{13}N$, $^{16}O(^3He,^7Li)^{12}N$, and $^{16}O(^3He,^7Be)^{12}C$ reactions at 70 MeV are also presented. (auth)

46671 NONRADIATIVE TRANSITIONS IN $^{13}C \rightarrow {}^9Be + \alpha$ system. Cherdantsev, P. A.; Gamalya, I. A. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 5, 24-7(1966). (In Russian).

One-dimensional spectra for the process $^{13}C \rightarrow {}^9Be + \alpha$ were calculated. The probability of nonradiative transitions and the probability of saturation of certain levels of the finite ^9Be nuclei were estimated. Considering that the maximum energy of ^{13}C is 8 MeV, the relative probability of all transitions on the levels (δ_500), (δ_700), ($\delta_{11}00$), and ($\delta_{12}00$) are equal to 1, 0.658, 0.0156, and 0.000192, respectively. (R.V.J.)

46672 EFFECTS OF THE RADIAL WAVE FUNCTIONS ON THE HIGH-ENERGY ELECTRON SCATTERING PROBLEM. Stovall, Tannie (Ecole Normale Superieure, Orsay, France). Nucl. Phys., A102: 554-62(1967).

Calculations of elastic and inelastic electron scattering from ^9Be are presented. The calculations are performed assuming that the nucleon motions are described by particles in a deformed square well. (auth)

46673 THE POLARIZATION OF THE NEUTRONS FROM THE REACTION $^{15}N(d,n_0)^{16}O$ AT $E_d = 4.35$ AND 5.50 MeV. Busse, W.; Efken, B.; Hilscher, D.; Scheer T, J. A.; Schroeder, W. U. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Z. Phys., 206: 404-5(1967).

In the reaction $^{15}N(d,n_0)^{16}O$, the angular dependence of the neutron polarization and of the differential cross section was measured at average deuteron energies of 4.35 and 5.50 MeV. Parallel features are observed. (auth)

46674 ELASTIC ELECTRON SCATTERING FROM ^{6}Li AND ^{7}Li. Suelzle, L. R.; Yearian, M. R.; Crannell, Hall (Stanford Univ., Calif.). Phys. Rev., 162: 992-1005(Oct. 20, 1967).

The nuclear-charge form factors for elastic electron scattering on ^{6}Li and ^{7}Li were determined from measurements at primary beam energies of 100 to 600 MeV. The maximum square of the momentum transferred to the nuclei was 6.9 F^{-2}. Absolute values of the cross sections were obtained by comparison with the known absolute proton cross section. For measurements at the primary-beam energy of 100 MeV, however, only the ratio of the ^{7}Li cross section to the ^{6}Li cross section was measured. The charge form factor for ^{7}Li could be interpreted in terms of a simple harmonic-oscillator shell model with a quadrupole contribution described by the undeformed p-shell model. For this model, the rms charge radius was 2.39 ± 0.03 F, and the electric-quadrupole moment required for the fit was in excellent agreement with the spectroscopic measurements. The ^{6}Li charge form factor could not be interpreted either in terms of the simple harmonic-well shell model, or in terms of the modified harmonic-well model in which the s and p nucleons are permitted to move in potential wells of different strengths. The rms radius obtained for a phenomenological fit to the data was 2.54 ± 0.05 F. The ratio of the ^{6}Li and ^{7}Li rms radii, as determined from the 100-MeV measurements, was 1.055 ± 0.008. This is in agreement with the ratio as determined from the best-fit form factors which were obtained from the complete range in q^2 of the data. (auth)

46675 ENERGY LEVELS OF ^{10}B. Purvis, J. D. (Haverford Coll., Pa.); Ajzenberg-Selove, F.; Polsky, L. M. Phys. Rev., 162: 1005-8(Oct. 20, 1967).

The reaction $^{11}B(^3He,\alpha)^{10}B$ was studied using 15- and 16-MeV ^{3}He particles and a broad-range spectrograph. Two new states of ^{10}B were located at $E_x = 11.53 \pm 0.04$ and 12.56 ± 0.03 MeV, with widths of 270 ± 50 and 90 ± 30 keV, respectively. (auth)

46676 SCATTERING OF NEUTRONS FROM ^{16}O IN THE 2.2- TO 4.2-MeV ENERGY RANGE. Johnson, C. H.; Fowler, J. L. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Phys. Rev., 162: 890-9(Oct. 20, 1967). (ORNL-P-2996).

The differential cross sections for scattering of neutrons from ^{16}O at some 14 energies between 2.2- and 4.2-MeV neutron energy were measured by detecting scattered neutrons. In the vicinity of the 3.77-MeV peak in the total cross section of ^{16}O, the total cross section was redetermined with a 5-keV energy spread. From a phase-shift analysis of this data and other data taken from the literature, resonance parameters were assigned for seven states of ^{17}O between 7.30- and 8.21-MeV excitation as follows (in order: excitation energy of ^{17}O, J value, parity, and reduced width in single-particle units, $\hbar^2/\mu a^2$): 7.30 ($3/2^+$, 0.23), 7.67 ($3/2^-$, 0.07), 7.691 ($1/2^-$, 0.03), 7.694 ($3/2^+$, 0.001), 7.91 ($1/2^-$, 0.02), 8.08 ($3/2^+$, 0.03), and 8.21 ($3/2^-$, 0.01). Finding the narrow $3/2^+$ state at 7.694 MeV has removed a difficulty in resonance-parameter assignment at the 3.77-MeV neutron energy peak in the total cross section of ^{16}O. (auth)

46677 FLUCTUATIONS IN EXCITATION FUNCTIONS FOR $^{12}C(^{16}O,\alpha)^{24}Mg$. Halbert, M. L.; Durham, F. E.; van der Woude, A. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Phys. Rev., 162: 899-918(Oct. 20, 1967). (ORNL-P-2969).

Cross sections were measured at five angles for alpha-particle groups from the reaction $^{12}C(^{16}O,\alpha)^{24}Mg$. The measurements were made with 40–50 keV resolution over energy intervals as long as 9.9 MeV (c.m.). The data provided large samples for fluctuation analyses over compound-nucleus excitation energies from about 25 to 35 MeV. The average coherence width, which is dominated by compound states with J ~ 10, was found to be about 118 keV. It does not vary significantly with exit channel, angle, or excitation energy in the compound nucleus. Most of the data are well represented by the simple Ericson–Brink–Stephen statistical model and show no significant direct-interaction component. A pronounced peak appearing in several of the excitation functions near 31.8-MeV bombarding energy is not consistent with this model. (auth)

46678 FLUCTUATIONS IN ANGULAR DISTRIBUTIONS OF $^{12}C(^{16}O,\alpha)^{24}Mg$. Halbert, M. L.; Durham, F. E.; Moak, C. D.; Zucker, A. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Phys. Rev., 162: 919-33(Oct, 1967). (ORNL-P-2982).

Angular distributions for a number of α-particle groups from $^{12}C(^{16}O,\alpha)^{24}Mg$ were measured with 45-keV resolution at closely spaced energies centered on bombarding energies of 19, 31, 42, and 49 MeV. Fluctuations of the type described by Ericson were observed. The data near 31 MeV were extensive enough to permit a statistical analysis. Compound levels with spins of about 10 are predominant at this energy. The average coherence width is about 125 keV and is independent of angle. No finer structure was found when the energy resolution was reduced to 15 keV. The strength of the fluctuations is generally in agreement with the ex-

pectation for a pure compound-nucleus process, though some anomalies were discovered. The coherence angle is about 6°, in agreement with expectation based on the size of the nucleus and the wave number. The angle-integrated average cross sections near 31 MeV are proportional to the statistical weights of the final levels. (auth)

46679 EXCITATION ENERGY OF THE FIRST EXCITED STATE OF ^{12}C, AND OBSERVATION OF A COHERENT DOPPLER EFFECT. Kolata, J. J.; Auble, R.; Galonsky, A. (Michigan State Univ., East Lansing). Phys. Rev., 162: 957-62(Oct. 20, 1967).

The excitation energy of the first 2^+ state in ^{12}C was determined to be 4440.0 ± 0.5 keV by means of the $(p,p'\gamma)$ reaction at 23-MeV incident proton energy. γ rays were detected by a Ge(Li) detector in coincidence with inelastically scattered protons to reduce Doppler broadening. An anomaly in which a symmetrical doublet appeared in the γ-ray singles spectrum observed at 90° to the beam direction is explained on the basis of a coherent Doppler effect involving selective population of the magnetic sublevels of the 2^+ state in the inelastic scattering process. (auth)

46680 INVERSE PHOTONUCLEAR PROCESS IN ^{16}O. Black, J. L.; O'Connell, W. J.; Hanna, S. S.; Latshaw, G. L. (Stanford Univ., Calif.). Phys. Lett., 25B: 405-7(Oct. 2, 1967).

Mild structure is observed in the main part of the giant resonance of ^{16}O by means of the reaction $^{15}N(p,\gamma_0)^{16}O$. Between E_x = 25 and 29 MeV the average $^{16}O(\gamma,p_0)^{15}N$ cross section is 50% of that in the main part of the resonance. (auth)

46681 SCATTERING OF 14.1-MeV NEUTRONS FROM ^{12}C. Grin, G. A. (Univ., Lausanne, Switzerland); Joseph, C.; Wong, C. Y.; Tamura, T. Contract W-7405-eng-26. Phys. Lett., 25B: 387-90(Oct. 2, 1967). (ORNL-P-3379).

It is shown that the simple collective model gives a fair description of the elastic scattering of 14.1-MeV neutrons from ^{12}C. In particular, the interpretation of the 0^+ (ground), 2^+ (4.43-MeV), 3^- (9.63-MeV), and 1^- (10.84-MeV) states as collective states gives good agreement with experiment. (auth)

46682 DOUBLE-NUCLEON EMISSION FOLLOWING THE ABSORPTION OF BOUND PIONS. Eisenberg, J. M. (Univ. of Virginia, Charlottesville); Letourneux, J. Contracts AT-(40-1)-2915; AT-(11-1)-1371. Nucl. Phys., B3: 47-72(1967). (ORO-2915-80).

The absorption of a bound pion on a correlated pair of nucleons is studied using a nonrelativistic pion–nucleon interaction. The pion is considered to be absorbed from a 1S or 2P atomic orbit, and modifications in its wave function due to strong interactions with the nucleus and to finite nuclear charge radius are included. In addition to correlations, in the initial nuclear wave function, mutual final state scattering of the emitted pair is taken into account. Terms arising in the treatment of the pion–nucleon interaction which contribute less than fifteen percent to the transition matrix element are consistently omitted. Angular correlations and energy distributions are considered as well as total absorption rates for the ejection of neutron–neutron and proton–neutron pairs. Numerical results are presented for ^{12}C and ^{16}O, and the comparison with experimental results is discussed. (auth)

Nuclear Properties and Reactions, $20 \leq A \leq 89$

Refer also to abstracts 45190, 45362, 46667, 46670, 46723, 46724, 46747, 46765, 46776, 46826, and 46831.

46683 (ANL-7325, pp 197-200) NUCLEAR CONSTANTS. Stupegia, D. C.; Tevebaugh, A. D.; Bingle, J. D. (Argonne National Lab., Ill.).

Developments are reported for studies on: neutron capture cross sections of reactor, structural, and control materials; and capture-to-fission cross-section ratios of fissile and fertile species. (P.C.H.)

46684 (LYCEN-6741) ETUDE DE LA REACTION S^{32}-$(n,\alpha_0)Si^{29}$: COURBE D'EXCITATION DE 3,25 A 5,15 MeV ET DISTRIBUTIONS ANGULAIRES A 4,1 ET 5,15 MeV. (Reaction $^{32}S(n,\alpha)^{29}Si$: Excitation Curves From 3.25 to 5.15 MeV and Angular Distributions at 4.1 to 5.15 MeV). Billerey, Roland (Lyon Univ. (France). Institut de Physique Nucleaire). June 1967. 80p. (In French). Dep. Thesis.

The excitation curve from 3.25 to 5.15 MeV and the angular distributions at 4.1 and 5.15 MeV were measured for the reaction $^{32}S(n,\alpha)^{29}Si$. A bibliographic review was made of the results obtained elsewhere on this reaction, and the results were compared. The experimental device used in the study is described in detail, and the results are reported. The results show that the limit of utilization of a single detector for the study of this reaction was attained because of the background of the detector itself. The angular distributions attained do not differ greatly from previous results. The formation of a compound nucleus can explain the results especially at E_n = 4 MeV. The direct interaction permits an agreement of the same order but seems to give a more certain distribution at 5.1 MeV. (J.S.R.)

46685 (LYCEN-6746) ETUDE DES REACTIONS (n,α) SUR S^{32} ET Ca^{40}. (Study of the Reactions (n,α) on ^{32}S and ^{40}Ca). Hajj-Boutros, Joseph (Lyon Univ. (France). Institut de Physique Nucleaire). July 1967. 96p. (In French). Dep. Thesis.

The PWBA method is reviewed with emphasis on the calculation of transition amplitudes. The geometric part of the problem is considered in some detail. The simple reaction mechanisms of pick-up and knock-out are then analyzed. The theoretical results are applied to the reactions $^{40}Ca(n,\alpha)^{37}Ar$ and $^{32}S(n,\alpha)^{29}Si$. The results obtained are discussed, and the mechanism proposed is critically evaluated. It is concluded that the $^{40}Ca(n,\alpha)^{37}Ar$ has an angular distribution that can be interpreted by a direct interaction process, a mixture of the pick-up and knock-out mechanisms. The $^{32}S(n,\alpha)^{29}Si$ reaction can also be interpreted by the same mechanism, but appears more probable to interpret it by the statistical model. (J.S.R.)

46686 (UCRL-17468) NUCLEAR DOUBLE RESONANCE DYNAMICS. McArthur, David Alexander (California Univ., Berkeley. Lawrence Radiation Lab.). July 1967. Contract W-7405-eng-48. 242p. Dep. CFSTI. Thesis.

A quantitative detailed study of the validity of the master equation with spin temperature assumption is used to describe the nuclear double resonance detection of a rare spin species. The technique of nuclear double resonance following adiabatic demagnetization of ^{19}F nuclei in the rotating frame (ADRF) has been used to study the resonance of 0.13% abundant ^{43}Ca in CaF_2. Radio frequency (rf) pulses were applied near the ^{43}Ca Larmor frequency after ADRF, and a study of cross-relaxation between ^{19}F dipolar energy and ^{43}Ca Zeeman energy in the rotating-frame effective field H_{eB}, measured the ^{19}F dipolar spectrum in CaF_2 for this kind of transition. The measured cross-relaxation rate decreases exponentially with increasing H_{eB} at θ = 90°, 60°, 45°, and 30°, and is proportional to $\sin^2\theta$ where θ is the angle between the laboratory magnetic field, H_0, and H_{eB}. A thermal-reservoir model of the cross-relaxation process, assuming slowly-varying spin temperatures for both the ^{19}F and ^{43}Ca nuclei, and assuming infinitely fast spin diffusion among ^{19}F nuclei, agrees with experiment at all values of θ, if a five-to-ten-degree misorientation of the crystal with respect to $\vec{H}_0$ is postulated. Audio saturation double resonance measurements of cross-relaxation rates yielded results in agreement with the pulsed experiments. Pulsed experiments showed no evidence of a finite ^{19}F spin diffusion rate. The first-order change in the cross-relaxation rate for small random quadrupole splittings of the ^{43}Ca resonance line is shown to vanish, and the second-order correction is partially calculated. The first measurements using double resonance were made of the transverse (T_2) and longitudinal (T_1) relaxation times of a rare spin species (^{43}Ca). Audio saturation double resonance following ADRF was used to separate the dipolar and inhomogeneous broadening of the ^{43}Ca resonance line; a method was also devised to measure the ^{43}Ca free induction decay indirectly. Both these methods showed that motionally narrowed dipolar broadening of the ^{43}Ca line was dominant for H_0 parallel to the [111] and [110] directions in CaF_2, the quadrupolar contribution to the line width being only about 200 Hz. A method was devised to measure indirectly the spin-lattice relaxation time T_1 of ^{43}Ca in CaF_2. The temperature dependence of T_1 agrees with the electric quadrupolar relaxation mechanism, and the values are: $T_1(300°K) = 236 \pm 27$ sec, $T_1(355°K) = 169 \pm 25$ sec. The technique of double resonance following ADRF was also used to search for resonances of the rare spins D, ^{17}O, ^{43}Ca, and ^{33}S in gypsum ($CaSO_4 \cdot 2H_2O$). A double quantum spin transition of D was observed near the D Larmor frequency, and other resonances were observed which are tentatively associated with ^{43}Ca and ^{33}S. (auth)

46687 PRODUCTION OF NUCLEAR FRAGMENTS OF ^8Li IN THE INTERACTIONS OF ANTIPROTONS AT 5 GeV/c. Baumann, Germain; Henry, Doris; Cuer, Pierre (Centre de Recherches Nucleaires, Strasbourg). Compt. Rend., Ser. A and B, 264: 1832-5 (June 26, 1967). (In French).

The rate of production of ^8Li fragments was determined to be 2.10 ± 0.10%. It is higher than in proton interaction. The energy spectrum and the angular distribution of these fragments were

also studied. These are compatible with the theory of evaporation being made with a decreasing nuclear temperature and potential barrier due to an expansion of the nucleus. (tr-auth)

46688 ELASTIC SCATTERING OF ANTIPROTONS AT 3 GeV/c ON THE NUCLEI OF IONOGRAPHIC EMULSIONS. Raffee, Kahn (Faculte des Sciences, Caen, France). Compt. Rend., Ser. A and B, 265: 91-3(July 3, 1967). (In French).

An angular distribution of the small elastic scattering angles below 10 mrd in the region of Coulomb nuclear interference led to the determination, within the framework of the optical model, of the parameters of this model and the ratio of the real and imaginary parts of the mean antiproton-nuclei scattering amplitude of the nuclear emulsion. (tr-auth)

46689 STRIPPING TRANSITIONS IN $^{46}Ti(^3He,d)^{47}V$. Dorenbusch, W. E.; Rapaport, J.; Belote, T. A. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Nucl. Phys., A102: 681-92(1967). (MIT-2098-344).

The $^{46}Ti(^3He,d)^{47}V$ reaction was studied at a bombarding energy of 12.0 MeV using the MIT multiple-gap spectrograph. A total of 18 transitions below 5.65 MeV of excitation were analyzed in the distorted-wave approximation to yield l_p values and spectroscopic strengths. Transitions to the analogues of the $1f_{\frac{7}{2}}$ state and the lowest lying $2p_{\frac{3}{2}}$ state in ^{47}Ti were observed. The level scheme is discussed. (auth)

46690 ENERGY DEPENDENCE OF THE ELASTIC SCATTERING AND POLARIZATION OF PROTONS ON ^{40}Ca. Gross, E. E.; Bassel, R. H.; Blumberg, L. N.; Morton, B. J.; van der Woude, A.; Zucker, A. (Oak Ridge National Lab., Tenn). Contract W-7405-eng-26. Nucl. Phys., A102: 673-80(1967). (ORNL-P-3165).

Absolute differential cross sections and polarizations for elastic proton scattering from ^{40}Ca were measured at incident proton energies of 35.8 and 45.5 MeV. These data, together with similar data at 30.0 and 40.0 MeV, were analyzed with a fixed geometry optical potential to obtain an energy dependence of the real-central well for ^{40}Ca of $dV_0/dE = -0.32$. Unsatisfactory optical-model fits to the large angle data are shown to be easily improved by a slight adjustment of the reflection coefficients associated with the nuclear surface. Calculated phase shifts give no indication of elastic scattering resonances in the energy range $30.0 \leq E_p \leq 45.5$ MeV. (auth)

46691 THE INELASTIC SCATTERING OF 17.8 MeV PROTONS FROM ^{58}Ni, ^{60}Ni, AND ^{120}Sn AND THE DETERMINATION OF SPIN AND PARITY ASSIGNMENTS FOR ^{58}Ni FROM α-PARTICLE SCATTERING. Jarvis, O. N.; Harvey, B. G.; Hendrie, D. L.; Mahoney, Jeanette (Univ. of California, Berkeley). Contract W-7405-eng-48. Nucl. Phys., A102: 625-54(1967). (UCRL-17352).

Protons of energy about 17.8 MeV were scattered from targets of ^{58}Ni, ^{60}Ni and ^{120}Sn. Precise angular distributions were obtained over the angular range 20 to 170° for most of the low-lying excited states in each nucleus. Also, 50 MeV α-particles were scattered from ^{58}Ni to determine the spin-parity assignments for a number of levels. Using these assignments, it was found that the ^{58}Ni proton scattering angular distributions for levels with the same spin and parity demonstrated definite similarities. Optical-model studies were made for the proton elastic scattering data, and the resulting potentials were used to obtain satisfactory DWBA predictions for the collective 2^+ and 3^- levels. The proton scattering angular distributions for many of the weaker levels were also found to resemble strongly the collective model DWBA predictions. (auth)

46692 ANALYSIS OF PARAMETERS OF RESONANCES IN COBALT AND MANGANESE INDUCED BY NEUTRONS OF ENERGY UP TO 120 keV. Morgenstern, J.; De Barros, S.; Bloch, A.; Chevillon, P. L.; Huynh, V. D.; Jackson, H. E.; Julien, J.; Lopata, C.; Samour, C. (Service de Physique Nucleaire a Basse Energie, Saclay, France). Nucl. Phys., A102: 602-24(1967). (In French).

The total neutron cross sections of ^{55}Mn and ^{59}Co were measured up to energies respectively equal to 80 keV and 500 keV. Experimental data were fitted with multi-level formulae by shape analysis; resonance parameters are given for ^{55}Mn up to 80 keV and for ^{59}Co up to 120 keV. For ^{55}Mn, the s-wave strength function S_0 is found to be equal to $(4.08^{+1.0}_{-0.7}) \times 10^{-4}$ eV$^{-\frac{1}{2}}$ and the potential scattering length R′ is found to be equal to 3.6 ± 0.4 fm. For ^{59}Co, $S_0 = (3.8 \pm 1.6) \times 10^{-4}$ eV$^{-\frac{1}{2}}$, R′ = 5.4 ± 0.5 fm; in this nucleus intermediate structure is observed. (auth)

46693 THE 2J + 1 RULE IN THE $^{25}Mg(d,\alpha)^{23}Na$ REACTION AT LOW ENERGIES. Wang, W. N.; Lin, E. K.; Chiba, Ren; Lee, T. J.; Yang, Y. C.; Hsu, C. C.; Chiao, T. (National Tsing Hua Univ., Taiwan, China. Academia Sinica, Taiwan, China). Nucl. Phys., A102: 537-44(1967).

The $^{25}Mg(d,\alpha)^{23}Na$ reaction was studied in the range $E_d = 2$ to 3 MeV. Alpha spectra were recorded at angles of 35 to 144° with an overall energy resolution of 60 keV. The total cross sections of 11 α-particle groups, integrated over the angles 35 to 155° and averaged over the deuteron energies 2 to 3 MeV, deviate from the 2J + 1 rule. The total cross sections calculated on the basis of the statistical compound nucleus theory are in good agreement with the experimental values. (auth)

46694 STUDY OF THE REACTION $^{20}Ne(^3He,p)^{22}Na$ AT $E_{^3He}$ = 3 MeV. Meynadier, Christian; Beaumevieille, Henri; Chambon, Bernard; Dumazet, Gerard; Lambert, Michel (Institut d'Etudes Nucleaires, Alger, France). Compt. Rend., Ser. A and B, 265: 159-61(July 10, 1967). (In French).

The differential cross section of the reaction $^{20}Ne(^3He,p)^{22}Na$ was measured at 3 MeV. The Newns theory was applied. The high absolute value of the differential cross section and the behavior of the angular distribution indicate that this reaction proceeds by direct interaction with respect to low-Q groups. Complementary measurements are underway to determine the parities of some excited states of ^{22}Na. (tr-auth)

46695 APPARENT THRESHOLD AND YIELD CURVE OF THE $^{23}Na(\gamma,\alpha n)^{18}F$ REACTION. Wilkniss, Peter (Naval Research Lab., Washington, D. C.). Radiochim. Acta, 8: 6-8 (Sept. 1967).

The yield curve of the $^{23}Na(\gamma,\alpha n)^{18}F$ reaction was determined by irradiating sodium samples with Bremsstrahlung up to 28 MeV from the NRL Linac. From the yield curve and from measurements made using an internal standard, an apparent threshold of 23 MeV was determined for the reaction. (auth)

46696 NUCLEAR STRUCTURE OF ^{22}Na. II. SOME GAMMA-RAY DOPPLER-SHIFT AND CORRELATION MEASUREMENTS. Poletti, A. R.; Warburton, E. K.; Olness, J. W.; Hechtl, S. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. Phys. Rev., 162: 1040-7(Oct. 20, 1967). (BNL-11430).

Levels of ^{22}Na below an excitation energy of 4.4 MeV were investigated through the $^{19}F(\alpha,n\gamma)^{22}Na$ and $^{20}Ne(^3He,p\gamma)^{22}Na$ reactions. Using the first reaction, initiated in a CCl_2F_2 gas target, the Doppler shifts of γ-ray transitions from the 0.891-, 2.211-, and 2.572-MeV levels were measured using α energies between 4 and 7 MeV. From these results upper limits were placed on the lifetimes of the three initial states. Combining these upper limits with previously obtained lower limits yields the following restrictions on the mean lifetimes (in psec) for these three levels: $8 < \tau < 52$, $11 < \tau < 42$, and $10 < \tau < 42$, respectively. Proton-γ angular correlations were measured at $E^3_{He} = 6.56$ MeV using the $^{20}Ne(^3He,p\gamma)^{22}Na$ reaction. These results gave information on γ-ray branching and multipole-mixing ratios and served to limit the possible spin-parity assignments of some of the levels. (auth)

46697 $^{89}Y(p,p')$ REACTION AT 14.71 MeV. Awaya, Yohko (Inst. of Physical and Chemical Research, Tokyo). J. Phys. Soc. Jap., 23: 673-83(Oct. 1967).

Excited states in ^{89}Y were investigated by studying elastic and inelastic scattering of 14.71-MeV protons. The scattered protons were detected with a broad-range magnetic analyzer. The angular distributions of the proton groups corresponding to the ground and thirteen excited states in ^{89}Y were obtained. The elastic scattering data are analyzed with the optical potential model. All the angular distributions obtained for the inelastic scattering are analyzed with the DWBA of one-phonon excitation process. The analysis with a single-particle excitation process is made for the 0.894-MeV ($\frac{9}{2}$+) and 1.50-MeV ($\frac{1}{2}$+) states and a pretty good fit is obtained for the 0.894-MeV state. The structure of the theoretical curve for the 1.50-MeV state is similar to that of the experimental data. On the basis of these results, the character of the excited states in ^{89}Y is discussed. (auth)

46698 NUCLEAR RESONANCE FLUORESCENCE OF HIGHLY EXCITED STATES OF ^{62}Ni, ^{114}Cd, AND ^{208}Pb. Starodubtsev, S. V.; Begzhanov, R. B.; Islamov, A. A. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk SSSR, 174: 332-3(May 11, 1967). (In Russian).

Resonance was investigated by using γ rays produced by capture of thermal neutrons in iron, using a new method for determining the radiative widths of high-energy nuclear states (Fleischman, Ann. Phys., 12: 133(1963)). The γ rays were registered with a shielded NaI(Tl) crystal. Measurements were made of the total width, the partial width for the radiative transition to the ground state, the statistical factor, the spacing between the emission and absorption lines, the effective pp scattering cross section, and the line intensities for the $^{57}Fe \rightarrow {}^{62}Ni$, $^{57}Fe \rightarrow {}^{114}Cd$, and $^{57}Fe \rightarrow {}^{208}Pb$ transitions. The partial widths were determined, some for the first time, from the self-absorption of the nuclear fluorescence

lines. The nuclear fluorescence measurements were repeated at several temperatures to confirm conclusively the presence of inelastic scattering in these interactions. (ATD)

46699 LEVELS IN ^{32}S OBSERVED THROUGH THE REACTIONS $^{31}P(p,\alpha_0)^{28}Si$ AND $^{28}Si(\alpha,\gamma)^{32}S$. Vernotte, J.; Langevin, M.; Takeutchi, F. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys., A102: 449-61(1967). (In French).

Eight resonance levels of ^{32}S were observed through the reactions $^{31}P(p,\alpha_0)^{28}Si$ (E_p = 1.4–1.9 MeV) and $^{28}Si(\alpha,\gamma)^{32}S$ (E_α = 3.7–4.3 MeV). The spins and parities of these levels were determined by angular correlation measurements. The resonance strengths are reported. (auth)

46700 PRODUCTION OF UNIFORM METAL FILMS FOR MEASUREMENT OF THE SOFT BETA RADIATION FROM ^{121}Sn. Schmidt, D.; Starke, K. (Univ., Marburg, Ger. Univ. of Kentucky, Lexington). Chem. Zvesti, 21: 579-85(1967). (In German).

For measurement of the soft β radiation of ^{121}Sn thin films of metallic tin were prepared by production and decomposition of SnH_4. The tin film possessed a very uniform strength, adhered well to the smooth quartz glass surface, and had a surface density on the order of 1 mg/cm^2. (tr-auth)

46701 INVESTIGATION OF EXCITED STATE OF ^{31}P WITH THE $^{30}Si(p,\gamma)^{31}P$ REACTION. Willmes, Henry; Harris, Gale I. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Phys. Rev., 162: 1027-35(Oct. 20, 1967).

Some previously unknown properties of excited states of ^{31}P were investigated by studying the γ rays from the reaction $^{30}Si(p,\gamma)^{31}P$. A coincidence spectrum taken at the resonance proton energy E_p = 1177 keV reduced the maximum possible branching ratio of the decay of the 2.23-MeV level via the 1.27-MeV level to 0.8%. Spectra taken at the E_p = 1694-keV resonance yielded decay schemes for the unbound level at 8.93 MeV and the bound levels at 4.78, 5.12, and 5.66 MeV. Angular-correlation measurements at the same resonance led to the assignment of $J^\pi = 5/2^+$ to the 4.78-MeV level. γ-ray linear-polarization measurements at the resonances at E_p = 1204, 1322, 1509, and 2187 keV verified experimentally the even-parity assignments for the levels at 3.29, 3.41, 3.51, and 4.26 MeV and the virtual levels at 8.45 and 8.75 MeV. By comparison of the polarization results with results of earlier triple-correlation measurements, the unique values $\delta = -0.41 \pm 0.03$ and $\delta = -0.32 \pm 0.04$ were obtained for the M1-E2 mixing ratios of the 3.51 → 0 and 4.26 → 0 transitions, respectively. (auth)

46702 EXCITATION OF LOW-LYING STATES OF ^{89}Zr BY THE (p,n) REACTION ON ^{89}Y. Kim, H. J.; Robinson, R. L. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Phys. Rev., 162: 1036-40(Oct. 20, 1967). (ORNL-P-3142).

Neutrons from the (p,n) reaction on ^{89}Y were investigated for the incident proton energies 5.503 and 5.770 MeV. The angular distributions of the neutrons corresponding to the (p,n) transitions to five low-lying states of ^{89}Zr were measured by the time-of-flight method in conjunction with a pulsed proton beam. The energies of the populated states are: ground state, 595 ± 10, 1095 ± 10, 1465 ± 10, and 1645 ± 10 keV. A spin and parity of $3/2^-$ was determined for the 1095-keV state. (auth)

46703 $^{46}Ti(^3He,d)^{47}V$ REACTION. Rosner, Baruch; Pullen, D. J. (Univ. of Pennsylvania, Philadelphia). Phys. Rev., 162: 1048-54(Oct. 20, 1967).

A high-resolution study of the $^{46}Ti(^3He,d)^{47}V$ reaction was made at a bombarding energy of 16.5 MeV. Fifty-three states were observed in ^{47}V up to an excitation energy of 7 MeV, and deuteron angular distributions were measured between 7 and 60°. Orbital-angular-momentum transfers and spectroscopic factors were evaluated for the more intense transitions with the aid of distorted-wave Born-approximation analysis. Of particular interest is the "anomalous" $3/2^-$ assignment for the ground state of ^{47}V. Other new spin-parity assignments for low-lying states in ^{47}V are the following: 0.089 MeV, $5/2^-$; 0.147 MeV, $1/2^-$; 0.260 MeV, $3/2^+$, and 1.664 MeV, $1/2^+$. The analog state to the 0.160-MeV ($1/2^-$) level in ^{47}Ti was located at 4.30-MeV excitation energy, which corresponds to a Coulomb displacement energy of ΔE_c = 7.84 ± 0.02 MeV for the ^{47}V-^{47}Ti isobaric pair. Evidence for possible deformation in ^{47}V is discussed. (auth)

46704 EXCITATION FUNCTIONS FOR RADIOACTIVE ISOTOPES PRODUCED BY PROTONS BELOW 60 MeV ON Al, Fe, AND Cu. Williams, I. R.; Fulmer, C. B. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Phys. Rev., 162: 1055-61(Oct. 20, 1967). (ORNL-P-3099).

Cross sections were measured for the production of radioisotopes by proton-induced reactions in natural aluminum, iron, and copper at bombarding energies of 60 MeV and lower. Most of the induced activities with half-lives of greater than 1 hr were recorded. Cyclotron-accelerated protons were used to bombard stacked foils which were subsequently individually analyzed for their γ radiation with a Ge(Li) spectrometer. Cross sections predicted from an evaporation theory and from cascade-evaporation theory were compared with experimental values; reasonable agreement was obtained. (auth)

46705 ANALYSIS OF THE $^{40}Ca(d,p)^{41}Ca$ REACTION. Butler, S. T.; Hewitt, R. G. L.; Truelove, J. S. (Univ. of Sydney). Phys. Rev., 162: 1061-9(Oct. 20, 1967).

The method recently developed by Butler, Hewitt, McKellar, and May (BHMM) is used in an analysis of the $^{40}Ca(d,p)^{41}Ca$ ground-state reaction for six different deuteron energies. The BHMM expression for the (d,p) differential cross section depends only on neutron and proton elastic scattering wave functions. In the present work, these are generated by optical parameters so chosen as to give elastic scattering cross sections in satisfactory agreement with experiment. The (d,p) angular distributions are then also found to be in good agreement with experiment. It is determined that the spectroscopic factor relating to the ^{40}Ca–^{41}Ca overlap has the value 0.56 ± 0.04. (auth)

46706 ONE- AND THREE-QUASIPARTICLE STATES OF OFF-MASS Ni ISOTOPES. Gambhir, Y. K. (Saha Inst. of Nuclear Physics, Calcutta); Raj, Ram; Pal, M. K. Phys. Rev., 162: 1139-46(Oct. 20, 1967).

The modified Tamm-Dancoff approximation was used to study the states of odd-mass Ni isotopes as the superposition of one- and three-quasiparticle states. The three-quasiparticle basic states are classified according to the well-known seniority scheme and are expressed in an equivalent second-quantized form. These three-quasiparticle states form an orthonormal and nonredundant set. The effect of the spurious 0^+ two-quasiparticle state was also removed from these basis wave functions. Several different kinds of two-body residual interaction were used in the calculation. Fairly decent agreement is obtained in the energy spectra between the present results and the exact shell-model results, using the effective interaction of Cohen et al. Various approximate methods, such as the perturbation theory and a phonon approximation are discussed in the context of the present method. The effect of the ground-state correlation is also studied. The admixture of the three-quasiparticle states in the lowest few levels causes very little change in the magnetic moment, and the M1 transition rates calculated on the basis of a single-quasiparticle structure of these states. The E2 transition rate is fairly sensitive to the admixture and the type of interaction used. (auth)

46707 ISOBARIC ANALOG STATES IN ^{56}Fe. Mehnert, R.; Otto, G.; Tomaselli, G. (Karl-Marx-Univ., Leipzig). Phys. Lett., 25B: 412-14(Oct. 2, 1967). (In German).

In the excitation curve of the reactions $^{55}Mn(p,\gamma)^{56}Fe$ and $^{55}Mn(p,n)^{55}Fe$, 8 isobaric analog resonances in the compound-nucleus ^{56}Fe were observed, corresponding to the low-lying levels of ^{56}Mn. The Coulomb displacement energy for the ground states of the pair ^{56}Mn–^{56}Fe is observed to be 8.59 ± 0.01 MeV. (auth)

46708 AN INVESTIGATION OF THE SMALL ANGLE j DEPENDENCE OF (α,t) REACTIONS ON ^{64}Ni AND ^{30}Si. Mizera, P. F.; Shreve, D. C.; Storm, D. W. (Univ. of Washington, Seattle). Contract AT(45-1)-1388. Phys. Lett., 25B: 400-2 (Oct. 2, 1967). (RLO-1388-36).

The small-angle j dependence of the (α,t) reaction on ^{64}Ni and ^{30}Si was investigated using 42-MeV α particles. An enhancement of the ratio $d\sigma(j = l - 1/2)/d\sigma(j = l + 1/2)$ is seen at small angles for the ^{30}Si reaction in agreement with theoretical predictions. (auth)

46709 ANGULAR DISTRIBUTIONS OF FAST NEUTRONS FROM THE REACTION $^{59}Co(p,n)$ AT E_p = 4.05 TO 5.23 MeV. Pospisil, S.; Rozkos, M.; Sterba, F.; Wilhelm, I. (Czech Technical Univ., Prague). Czech. J. Phys., 17: 707-10(1967).

The angular distributions of neutrons from the reaction $^{59}Co(p,n)$ for 4 values of the proton energy E_p = 5.23 to 4.05 MeV were measured. The preliminary analysis of the results shows that in the reaction mechanism a certain role is played also by a direct process, most probably of a knock-out type, the relative contribution to the reaction yield of which decreases with decreasing value of E_p. (auth)

46710 PRECISE REDETERMINATION OF THE $P_K\omega_K$-VALUE AND THE FLUORESCENCE YIELD ω_K OF Cr AFTER ELECTRON CAPTURE DECAY OF ^{54}Mn. Bambynek, W. (EURATOM, Geel, Belg.). Z. Phys., 206: 66-74(1967).

The $P_K\omega_K$-value of Cr following ^{54}Mn decay was determined using two independent precision methods for both the measurements of the K x-ray emission rate and the disintegration rate. For $P_K\omega_K$ a value of 0.2514 ± 0.0008 was obtained. Using P_K = 0.900 deduced

from literature, the fluorescence yield of Cr was found to be ω_K = 0.2793 ± 0.0017. A discussion of the statement of errors is given. (auth)

46711 PHOTONUCLEAR CROSS SECTIONS WITH MONO-ENERGETIC NEUTRON-CAPTURE GAMMA RAYS. Hurst, F. R. (Univ. of Missouri, Columbia); Donahue, D. J. Nucl. Phys., A91: 365-8(1967).

Monoenergetic gamma rays produced by thermal neutron capture in various nuclei were used to measure (γ,n) cross sections in several targets. Cross sections for selected energies between 7.72 and 10.83 MeV, for a range of targets with mass numbers between A = 59 and 209 are presented. (auth)

46712 ENERGY LOSS OF PROTONS WITH ENERGIES UP TO 30 MeV IN DIFFERENT MATERIALS. Tschalar, Christoph. Los Angeles, Univ. of Southern California, 1967. 178p.

Thesis.

The energy loss of protons in Be, Al, Si, lucite, sapphire, and quartz was measured. The incident energy of 20 MeV was determined by a magnetic spectrometer to 0.1% accuracy. The final energy of 3 MeV to 18 MeV was measured by a Li-drifted silicon detector to an accuracy of 24 keV. The straggling distribution and the correction for multiple scattering for the final energy were calculated numerically. The mean excitation potentials I were determined by a least squares fit of the theoretical range function to the experimental data as I_{Be} = 66.8 eV, I_{Al} = 167.0 eV, I_{Si} = 173.5 eV, I_{lucite} = 74.2 eV, $I_{sapphire}$ = 145.2 eV, and I_{quartz} = 139.2 eV. The error of I was ±0.5%. The I-value of sapphire deviates from the one obtained from the Bragg-rule by 11%; the I-value of quartz deviates by 7%. (Disser. Abstr.)

46713 BETA-GAMMA (CIRCULARLY POLARIZED) CORRELATION AND GAMMA-SPECTROSCOPIC STUDIES ON ^{27}Mg. Bigoni, Robert Allen. Davis, Calif., Univ. of California, 1966. 53p.

Thesis.

Studies were made of the circular-polarization of the two high-energy γ rays (1.01 and 0.84 MeV) following the two-branch β^- decay of ^{27}Mg to ^{27}Al. The photon (that is, γ) spin polarization is a result of its being detected in coincidence with an immediately preceding β particle which possesses, in the relativistic limit, 100% longitudinal polarization (transferred in part to the γ-ray) by virtue of the complete breakdown of parity in β-decay. The γ-ray polarization measurements were done with γ polarimeters based on the principle of the dependence of the Compton scattering cross section on the relative orientation of electron spin and photon spin. The γ polarimeters were geometrical configurations of magnetized iron which provided collections of partially aligned electrons from which the γ rays could Compton-scatter. A computer calculation of the detection efficiency of one of these configurations (two were utilized in the present work) was necessary in order to separate the effects due to the two γ rays of principal interest in this investigation. The polarimeter results for the two γ rays of concern are given, as usual, in terms of an asymmetry parameter, A, which gives the photon polarization when the angle between the photon and its coincident β particle is 0°. In addition, a spectroscopic study of all three γ rays (1.01, 0.84, and 0.175 MeV) involved in this decay was made using a Li-drifted germanium detector in conjunction with standard techniques of multichannel pulse-height analysis. The purpose of these measurements was to increase the knowledge concerning the following parameters characterizing the β decay of ^{27}Mg and the excited-state structure of ^{27}Al: the beta-branching ratio for the two modes of decay of ^{27}Mg; the relative γ intensities of the 0.175- and 1.01-MeV γ rays from the 1.01-MeV ^{27}Al state; the (E2/M1) radiation amplitude ratio (E2 ≡ electric quadrupole, M1 ≡ magnetic dipole) characterizing the ground-state transition ($^5/_2^+ \rightarrow {}^5/_2^+$) from the 1.01-MeV level; and the Fermi to Gamow-Teller matrix element ($C_V M_F / C_A M_{GT}$) ratio characterizing the β-branch connecting ^{27}Mg ($^1/_2^+$) and the 0.84-MeV level ($^1/_2^+$) in ^{27}Al. (TSN) (Disser. Abstr.)

Nuclear Properties and Reactions, A ≥ 90

Refer also to abstracts 45085, 45171, 45190, 46477, 46642, 46643, 46670, 46683, 46691, 46698, 46711, 46794, and 46831.

46714 (AD-638005) VARIATION OF NUCLEAR CHARGE DISTRIBUTION IN FISSION WITH BOMBARDING ENERGY. Final Report. Yaffe, Leo (McGill Univ., Montreal (Quebec). Dept. of Chemistry). Aug. 9, 1966. Contracts AF-AFOSR-62-24; AF-AFOSR-489-64. 6p. (AFOSR-66-1763). CFSTI.

Independent and cumulative cross sections were determined for the formation of a large number of nuclides formed in the fission of ^{233}U, ^{235}U, ^{238}U, and ^{232}Th by protons of energies from 8 to 100 MeV. Charge dispersion curves were constructed. In general, the curves broaden with increasing proton energy, attributable to a greater variety of fissionable parents as neutron evaporation becomes more competitive with fission. The most probable charge formed in fission moves towards stability, and neutron-deficient products appear in good yield. Excitation function was constructed for each of the fission products and additional data added to those previously obtained by Friedlander et al. (Phys. Rev., 129: 1809(1963)). The variation with bombarding energy of the isomer ratio of the metastable to ground state of some of the fission products was studied. Theoretical calculations were made to elucidate the behavior. (auth) (TAB)

46715 (BNL-11796) PROPERTIES OF NUCLEI IN THE TRANSITION REGION. Scharff-Goldhaber, G. (Brookhaven National Lab., Upton, N. Y.). Sept. 29, 1967. 18p. (CONF-670910-4). Dep. CFSTI.

From International Conference on Nuclear Structure, Tokyo, Japan.

The level structure of nuclei in the transition region is discussed, considering both experimental observations and theoretical interpretations. Some recent observations on the β-vibrational bands in these nuclei are summarized, and a description of ground-state bands in even-even nuclei that is based on an axially symmetric rotor model is outlined. (D.C.W.)

46716 (BNL-50045) MULTILEVEL ANALYSIS OF THE ^{235}U TOTAL AND FISSION CROSS SECTIONS IN THE ENERGY REGION BELOW 37 eV. Adler, D. B.; Adler, F. T. (Brookhaven National Lab., Upton, N. Y.). Mar. 1967. 74p. Dep. CFSTI.

A multilevel analysis of the neutron fission and total cross sections of ^{235}U for neutron energies below 37 eV is outlined, and the resonance parameters obtained are tabulated. A shape analysis based on the least-squares technique was used. (D.C.W.)

46717 (COO-1672-5) COLLECTIVE EFFECTS IN RADIATIVE CAPTURE REACTIONS AND IN NUCLEAR SPECTROSCOPY. Progress Report, January-September 1967. Daly, Patrick J. (Purdue Univ., Lafayette, Ind. Dept. of Chemistry). Contract AT(11-1)-1672. 24p. Dep. CFSTI.

The energy levels of ^{151}Gd, ^{184}Os, and ^{181}Re were investigated by measuring the energies and relative intensities of γ rays emitted in the decays of ^{151}Tb, ^{184}Ir, and isomeric ^{181}Os, respectively. Level schemes for ^{151}Gd and ^{181}Re were established. The ground-state rotational and γ-vibrational bands of ^{184}Os were identified, and the conversion coefficients for many of the low-energy transitions in ^{151}Gd were estimated. Similar measurements of γ energies and intensities in the decays of ^{186}Ir and 20-hr ^{181}Re were also made. Additionally, excitation functions for the spallation reactions ^{181}Ta(α,xn)$^{185-x}$Re, ^{181}Ta(He-3,xn)$^{184-x}$Re, ^{207}Pb(He-3,xn)$^{210-x}$Po, and ^{209}Pb(He-3,xn)$^{211-x}$Po, where x = 1 through 4, were measured. Notable differences between the curves for the corresponding α and ^{3}He-induced reactions were observed. It was also found that the sum of the (He-3,xn) curves is considerably less than that of the (α,xn) curves. Measurements of the excitation functions for some ^{3}He-induced reactions in this mass region indicated that charged-particle emission does not account for the difference between the two total reaction cross sections. (D.C.W.)

46718 (IN-1096) FISSION PRODUCT TRANSIENT MEASUREMENTS IN THE ADVANCED REACTIVITY MEASUREMENT FACILITIES. Nisle, R. G.; Stepan, I. E.; Millsap, D. A.; Fast, E. (Idaho Nuclear Corp., Idaho Falls). Sept. 1967. Contract AT(10-1)-1230. 27p. Dep. CFSTI.

The yields of ^{135}I in the fission of ^{233}U, ^{239}Pu, and ^{241}Pu relative to that for ^{235}U were measured by an integral method using the Advanced Reactivity Measurement Facilities (ARMF I and II). The xenon reactivity transient was measured following irradiation of the fissile isotope in the Materials Testing Reactor (MTR) for periods from 2.5 to 110 days. The use of the two ARMF reactors permits the calculation of the absorption cross sections of both simple absorbers and fissile atoms. Calibration and data reduction techniques make extensive use of digital computer codes and take account of nonlinear reactivity responses of the reactors. The ^{135}I yield ratios, relative to ^{235}U, were found to be 0.825 ± 0.072 for ^{233}U, 1.006 ± 0.067 for ^{239}Pu, and 1.221 ± 0.089 for ^{241}Pu. The quoted uncertainties are confidence intervals at the 90% confidence level. (auth)

46719 (JINR-P6-3479) METOD OBRABOTKI DVUKHMERNYKH SPEKTROV SOVPADENII I EGO PRIMENENIE K ANALIZU γ-γ SOVPADENII NA Ge(Li) DETEKTORAKH PRI RASPADE ^{155}Tb. (Method of Data Processing of Two-Dimensional Coincidence Spectra and Its Application for the Analysis of γ-γ Coincidence Spectra Measured in ^{155}Tb with Ge(Li) Detectors). Galan, P.; Kuznetsova, M. Ya.; Finger, M.; Yursik, I.

(Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1967. 46p. (In Russian). Dep.

The method of data processing of two-dimensional coincidence spectra is described and its application for the $\gamma-\gamma$ coincidence spectra analysis in ^{155}Tb is shown. The existence of levels with energies 86.5; 105.3; 118.0; 235.2; 266.6; 268.6; 286.8; 326.0; 377.7; 427.4; 451.3, and 488.8 keV in the ^{155}Gd nucleus is proved on the basis of $\gamma-\gamma$ coincidences measured in ^{155}Tb decay with Ge(Li) detectors. Two new transitions with energies of ~192 and ~163 keV were found. (auth)

46720 (JINR-P7-3202) TRUDY MEZHDUNARODNOI KONFERENTSII PO FIZIKE TYAZHELYKH IONOV, DUBNA, 13-19 OKTYABRYA 1966 g. VYPUSK 1. PROTONNYE IZLUCHATELI I AL'FA-RASPAD YADER. (Proceedings of the International Conference on Heavy Ion Physics, Dubna, October, 1966. Issue I. Proton Emitters and Alpha-Decay of Nuclei). (Joint Inst. for Nuclear Research, Dubna (USSR)). 1967. 87p. (In Russian). (CONF-661035-2). Dep.

Papers dealing with delayed proton emitters heavier than Sn, alpha and proton radioactivity near magic nuclei, two-proton radioactivity, and alpha activities in the region from Ir to Po are included. (D.C.W.)

46721 (KFK-519) BESTIMMUNG EINIGER ANREGUNGSFUNKTIONEN FUER DEUTERONENREAKTIONEN MIT Pr-141. (Determination of Some Excitation Functions for Deuteron Reactions With ^{141}Pr). Lange, Juergen (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). Feb. 1967. 75p. (In German). Dep.

The (d,p), (d,2n), and (d,3n) effective cross sections for ^{141}Pr were determined using the internal beam of the Karlsruhe isochronous cyclotron. A rarely used monitor method in which target and monitor substances were homogeneously mixed with each other was used for current measurement. The principle of this method is reported and other methods of current measurement are described for comparison. The absolute effective cross sections were measured by this method, and the pattern of the excitation functions for the nuclear reactions considered were determined and were qualitatively evaluated. An error evaluation was made, and results for the mixed monitor method were compared with the usual monitor methods. The yield for the irradiation of thick-targets was calculated using the excitation function. Using the activities produced for the determination of the effective cross sections, an accurate half-life determination was also made for ^{141}Pr. A previously unknown ground state of ^{139}Nd was found, and some decay data were determined for it. For deuteron energies under the range of application of the monitor reaction, effective cross-section ratios were measured for the (d,2n) and (d,p) reactions. Some of the operational steps which were of significance for the accuracy of the cross sections determined were investigated. These were the absolute calibration with the 4π counter, activation measurements with the calibrated γ spectrometer and the calibrated β counter, separation of lanthanides by ion exchange chromotography, and yield determination by complexometric titration. (tr-auth)

46722 (NAA-SR-12271(Suppl.1)) NEUTRON CROSS SECTIONS FOR ^{239}Pu, ^{242}Pu, AND ^{244}Cm. Supplement I. Dunford, C. L.; Alter, H. (Atomics International, Canoga Park, Calif.). Sept. 15, 1967. Contract AT(04-3)-701. 5p. Dep. CFSTI.

Some corrections to the cross-section data for ^{244}Cm, ^{238}Pu, and ^{242}Pu that were presented in NAA-SR-12271 are summarized. (D.C.W.)

46723 (ORNL-4164, pp 1-23) NUCLEAR CHEMISTRY. (Oak Ridge National Lab., Tenn.).

Neutron cross sections and resonance parameters, nuclear decays, heavy-ion-induced reactions, neutron- and proton-induced fission, nuclear level schemes, and fission-product yields and decay properties were investigated experimentally. An iron-free $\pi\sqrt{2}$ electron spectrometer was developed, as was a low-level gamma spectrometer for analysis of lunar samples. (D.C.W.)

46724 (TID-22361(Pt.2)) A COMPILATION OF BETA EXCITED X-RAY SPECTRA. PART II. (^{90}Sr-^{90}Y, ^{63}Ni, ^{204}Tl). Preuss, Luther E.; Artman, C.; Bugenis, C.; Collins, H. (Edsel B. Ford Inst. for Medical Research, Detroit, Mich.). Oct. 1967. Contract AT(11-1)-1239. 226p. Dep. CFSTI.

The x-ray spectra resulting from the exposure of a number of elements to the beta particles from ^{63}Ni, ^{90}Sr-^{90}Y, and ^{204}Tl are presented. The spectra were measured using proportional and scintillation counters. The experimental conditions are given with each spectrum. (D.C.W.)

46725 (UCD-CNL-88) [EXPERIMENTAL NUCLEAR PHYSICS]. Annual Report. Jungerman, John A.; True, William W. (California Univ., Davis. Crocker Nuclear Lab.). Sept. 15, 1967. Contract AT(11-1)-Gen-10. 46p. Dep. CFSTI.

A review is given of the operating experience for the 76-in. cyclotron at the Crocker Nuclear Laboratory. Data are given for the gamma spectra from (α,nγ) reactions on ^{130}Ba and ^{117}Sn at 45 MeV. (S.F.L.)

46726 (UCRL-17765) OPTICAL PUMPING IN ATOMIC LEAD. Chang, Berken (California Univ., Berkeley. Lawrence Radiation Lab.). Aug. 28, 1967. Contract W-7405-eng-48. 108p. Dep. CFSTI.

Thesis.

The optical orientation of the nucleus in the $6s^26p^2\ ^3P_0$ ground state of ^{207}Pb was attempted. Light sources with differing ratios of hyperfine intensities are evaluated to determine their contribution. These sources, in particular a pressure-shifted-hyperfine-absorption filter and a self-reversed ^{208}Pb lamp, were studied spectroscopically and were then used for pumping. Optical pumping rate equations were used to estimate the signal to noise as a function of R, the ratio of the hyperfine intensities and k, the mixing parameter. Radioisotope lead lamps were also developed for use in future pumping of ^{205}Pb or ^{205}Pb. A detection system was developed which has sufficient sensitivity to detect a signal when the relaxation time is greater than 10 msec. No signal is seen in cells without a buffer gas, with 10 torr of He buffer, and with 100 torr He buffer. The shortness of the relaxation time deduced for an unbuffered cell is partially explained by the length of the cell wall adsorption time of a lead atom. The shortness of the relaxation time when using a helium buffer is surprising and suggests that the ground state of Pb may not be spherically symmetrical on buffer gas collisions. (auth)

46727 (UCRL-50243(Vol.3)) THE FISSION PRODUCT DECAY CHAINS (^{239}Pu) WITH FISSION SPECTRUM NEUTRONS. VOLUME III. ROENTGENS PER HOUR PER KILOTON PER SQUARE MILE VS. TIME. Fleming, Edward H. Jr. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 31, 1967. Contract W-7405-eng-48. 305p. Dep. CFSTI.

Plots of Roentgens/hr/kton/mi^2 vs time are presented for the fission products of ^{239}Pu in a fission spectrum. (D.C.W.)

46728 (LA-tr-67-80) SPECTRUM OF GAMMA RAYS FOLLOWING THE CAPTURE OF THERMAL NEUTRONS BY PLATINUM. Groshev, L. V.; Demidov, A. M.; Rakhimov, A. S. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). Translated by Helen J. Dahlby (Los Alamos Scientific Lab., N. Mex.), from report IAE-1386. 14p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

A magnetic Compton spectrometer with a resolution of 0.3% was used to measure the spectrum of γ rays originating in a natural mixture of platinum isotopes during irradiation with thermal neutrons. A table of the energies and intensities of the measured gamma lines is given. The main part of these γ lines belongs to the emitting isotope ^{196}Pt. On the basis of the data obtained, a level scheme of ^{196}Pt up to an excitation energy of ~3 MeV is proposed. The structure of the γ-ray spectra in the region from 4 to 6.5 MeV with the trend to the doubly magic ^{208}Pb nucleus is discussed. (auth)

46729 RADIOCHEMICAL INVESTIGATION OF ^{238}U SPONTANEOUS FISSION. Rao, M. N. (Univ., Cologne). Radiochim. Acta, 8: 12-15(Sept. 1967).

Strontium, cesium, and barium isotopes were isolated from kilogram amounts of natural uranium salts and minerals and after rigorous purification and the radioactivities were measured by low-level counting techniques. The equilibrium activities (in disintegrations per second per gram U) calculated for these isotopes are: ^{89}Sr = (2.7 ± 0.9) × 10^{-4}; ^{90}Sr = (4.3 ± 1.4) × 10^{-4}; ^{136}Cs = (5.5 ± 1.1) × 10^{-4}; and ^{139}Ba = (4.5 ± 1.0) × 10^{-4}. An attempt was made to discuss the fission yields of A = 131 to 136 in ^{238}U spontaneous fission. (auth)

46730 INVESTIGATION OF PARITY IMPURITY IN A NUCLEAR γ TRANSITION. de Saintignon, Paul; Lucas, Jean-Jacques; Depommier, Pierre (Univ., Grenoble, France. CEN, Grenoble, France). Compt. Rend. Ser. A and B, 265: 94-6(July 3, 1967). (In French).

The degree of circular polarization of the 482-keV γ radiation of ^{181}Ta($^9/_2^+ \rightarrow\ ^7/_2^+$) was measured. A value of P = +1.5 ± 2.7 × 10^{-4} was obtained. (tr-auth)

46731 HALF-LIFE OF THE 71.2-keV LEVEL OF ^{171}Lu. Gizon, Jean; Gizon, Andree; Valentin, Jacques (Faculte des Sciences, Grenoble, France. CEN, Grenoble, France). Compt. Rend., Ser. A and B, 265: 97-100(July 3, 1967). (In French).

The half-life of the 71.2-keV level in the decay of ^{171}Hf was measured by radioactive decay. Its value of 79 ± 2 sec involves a hindrance factor F_N of the order of 1. (tr-auth)

46732 THE γ SPECTRUM EMITTED DURING THE TRANSMUTATION OF ^{155}Sm INTO ^{155}Eu. Widemann, Francois; Sebille, Claire; Leang, Chin-fan (CNRS, Orsay, France). Compt. Rend., Ser. A and B, 264: 1843-5(June 26, 1967). (In French).

The γ spectrum of the transmutation ^{155}Sm → ^{155}Eu (23 min) was observed using a Ge–Li detector with a transistorized preamplifier. The resolution of 1.7 keV at 100 keV permitted new rays to be detected and the precision of the energies and intensities to be improved. (tr-auth)

46733 THE ISOMER ^{130m}I. INVESTIGATION OF A DECAY SCHEME. Kellershohn, Claude; Comar, Dominique; Riviere, Rene (CEA, Gif-sur-Yvette, France). Compt. Rend., Ser. A and B, 265: 88-90(July 3, 1967). (In French).

^{130m}I decays either by isomeric transition to the ground level of ^{130}I or by β^- decay to excited levels of ^{130}Xe. By interpretation of the experimental data presented previously, values are proposed for the energies, the spins, and the parities of different levels. (tr-auth)

46734 THE ISOMER ^{130m}I. EVIDENCE AND STUDY OF THE RADIATION EMITTED. Kellershohn, Claude; Comar, Dominique; Riviere, Rene (CEA, Gif-sur-Yvette, France). Compt. Rend., Ser. A and B, 264: 1836-9(June 26, 1967). (In French).

The circumstances leading to the detection of an isomer of ^{130}I are described. The half-life (9.2 min) and the nature and spectral distribution of the radiation of this isomer are specified. (tr-auth)

46735 NUCLEAR PHOTOACTIVATION OF Hg. Boivin, Michel (Laboratoire de Chimie Physique, Paris). Compt. Rend., Ser. A and B, 264: 1984O-2(June 26, 1967). (In French).

The photoactivation of natural Hg in the solid state was studied. Four previously unknown nuclear levels at 1,380, 1,420, 1,530, and 1,700 keV were detected for ^{199}Hg. The corresponding cross sections were determined, and spin-parity assignments for these levels were proposed. (tr-auth)

46736 NEUTRON SINGLE-PARTICLE STATES IN ^{143}Nd AND ^{145}Sm. Christensen, P. R.; Herskind, B.; Borchers, R. R.; Westgaard, L. (Univ. of Copenhagen). Nucl. Phys., A102: 481-502(1967).

States in ^{143}Nd and ^{145}Sm were investigated by the ^{142}Nd(d,p) and ^{144}Sm(d,p) reactions at a deuteron energy of 12 MeV. Additional information on these states were obtained from the ^{143}Nd(d,d') reaction and by measurements of the gamma rays in coincidence with the stripping protons (d,pγ). The l-values, spins, parities, and spectroscopic factors were determined for a number of states in each of these nuclei. (auth)

46737 ISOMER RATIO FROM THE ^{203}Tl(n,2n)^{202m,g}Tl REACTION AND HALF-LIFE OF ^{202m}Tl. Scheimbauer, P.; Hille, P. (Institut fuer Radiumforschung und Kernphysik, Vienna). Nucl. Phys., A102: 534-6(1967). (In German).

The isomer ratio from the ^{203}Tl(n,2n)^{202m,g}Tl reaction was investigated with neutrons of 14.1 ± 0.15 MeV energy. The half-life of the isomeric state was remeasured by a pulsed beam technique and found to be $T_{\frac{1}{2}}$ = 608 ± 22 μsec. The isomer yield was measured relative to the ground state yield and the isomer ratio $\sigma_m/(\sigma_m + \sigma_g)$ = 0.34 ± 0.044 was obtained. The spin cutoff parameter σ = 3.7 ± 0.4 was calculated by the method of Huizenga and Vandenbosch. (auth)

46738 STUDY OF ^{179}Hf BY THE (n,γ) REACTION. Manfrass, P. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.; Andreeff, A.; Kaestner, R.; Bondarenko, W.; Kramer, N.; Prokofjew, P. Nucl. Phys., A102: 563-76(1967). (In German).

The decay of the excited states of ^{179}Hf was studied, using the thermal neutron capture reaction. The low-energy conversion electron spectrum, the high- and low-energy gamma-ray spectrum and the $\gamma-\gamma$ coincidence spectrum were measured with a detector combination of Ge(Li)-NaI(Tl). The excitation energy of the states $^5/_2^-$ [512] (518.2 keV), $^1/_2^-$ [521] (614.2 keV), $^3/_2^-$ [512] (720.2 keV), $^1/_2^-$ [503] (871.6 keV) and their rotational bands was investigated. (auth)

46739 STUDY OF ^{175}Yb BY THE (n,γ) REACTION. Bondarenko, W. (Inst. of Physics, Riga); Kramer, N.; Prokofjew, P.; Manfrass, P.; Andreeff, A.; Kaestner, R. Nucl. Phys., A102: 577-92(1967). (In German).

The decay of the excited states of ^{175}Yb was studied, using the thermal neutron capture reaction. The low-energy conversion-electron spectrum, the high- and low-energy gamma-ray spectrum and the $\gamma-\gamma$ coincidence spectrum were measured with a β-spectrograph and detector combination of Ge(Li)-NaI(Tl). A new $^3/_2^+$ level at 1066 keV was observed. The structure of this level is probably: $^3/_2^+$[642] + ($^7/_2^-$[514] + Q_{22}). Intensive primary transitions from the capture state populate the $^3/_2^-$ levels of the rotational bands $^1/_2^-$[510], $^3/_2^-$[512] and $^1/_2^-$[521] and new levels at 1892, 1935, 2107, 2137, and 2187 keV. The relative intensity of the primary transitions from the capture state to the levels $^1/_2^-$[510] and $^1/_2^-$[521] is very small. (auth)

46740 ENERGY OF THE ISOMERIC TRANSITION IN ^{109}Ag. Schima, F. J.; Hutchinson, J. M. R. (National Bureau of Standards, Washington, D. C.). Nucl. Phys., A102: 667-72 (1967).

The energy of the isomeric transition in ^{109}Ag from the decay of ^{109}Cd was measured by intercomparison with X-rays of well-known energies. Using a Ge(Li) detector with 1.45 keV resolution, the gamma-ray energy was found to be 88.041 keV with an uncertainty believed to be less than 0.087 keV. (auth)

46741 ISOBARIC YIELD DISTRIBUTION IN THE FISSION OF URANIUM BY MEDIUM-ENERGY PROTONS. Parikh, S. S.; Marsden, D. A.; Porile, N. T.; Yaffe, L. (McGill Univ., Montreal). Can. J. Chem., 45: 1863-74(Aug. 15, 1967).

The independent formation cross sections of ^{139}Ba, ^{139}Ce, ^{141}Ce, and ^{143}Ce, and the cumulative formation cross sections of ^{139}Cs, ^{141}Ba, and ^{143}La, produced from the fission of natural uranium by protons of energies from 20 to 85 MeV, were measured radiochemically. The proton energies at which the excitation functions reach their maxima correlate well with the neutron-to-proton ratio of the fission product. Nuclear charge-dispersion curves exhibit, with increasing proton energy, the behavior previously found by other workers, i.e., broadening and a shift of the most probable nuclear charge towards stability. (auth) (CANADA)

46742 ELECTRIC MONOPOLE TRANSITION IN ^{98}Mo. Hubenthal, Karlheinz; Berthier, Jean; Hocquenghem, Jean-Claude; Moussa, Andre (CEN, Grenoble, France). Compt. Rend., Ser. A and B, 265: 162-4(July 10, 1967). (In French).

A level O^+ at 735 keV was detected in ^{98}Mo. It is fed by the decay of ^{98}Nb (2.8 sec). The half-life was measured to be 22 nsec, and the strength parameter ρ = 0.17 was compared with those of other EO transitions. (tr-auth)

46743 SPIN ASSIGNMENT TO SOME LEVELS OF ^{127}I. Vasudev, C. M.; Suri, K. K.; Trehan, P. N. (Panjab Univ., Chandigarh, India). Indian J. Pure Appl. Phys., 5: 182-3(May 1967).

Theoretical neutron inelastic scattering cross-sections for the 418, 612, 646, and 744 keV levels of ^{127}I for various spin assignments were obtained by the method of W. Hauser and H. Feshbach [Phys. Rev., 87(1952), 366] and compared with the experimental values as determined by D. A. Lind and R. B. Day [Ann. Phys., 12(1961), 485]. The study indicates that $^7/_2$+, $^3/_2$+, and $^{11}/_2$+ are the most probable spin assignments for 612, 646, and 744 keV levels respectively. Also the $^5/_2$+ spin assignment to the 418 keV level is confirmed. (auth)

46744 TIN AND ANTIMONY ISOTOPES OF MASS 129 IN FISSION. Birgul, O.; Lyle, S. J. (Univ. of Kent, Canterbury, Eng.). Radiochim. Acta, 8: 9-12(Sept. 1967).

Experiments have confirmed the presence of two ^{129}Sn isomers in fission. The half-life of the longer-lived isomer was found to be 7.5 ± 0.1 min and that of the shorter-lived isomer about 2 min. Convincing evidence was not obtained for a longer-lived isomer previously reported. Cumulative yields of 0.17 ± 0.01 and 0.39 + 0.03% for 7.5-min. ^{129}Sn and ^{129}Sb, respectively, were obtained from the thermal neutron-induced fission of ^{235}U. (auth)

46745 ^{132}Cs GAMMA RADIATION. Frana, J.; Rezanka, I.; Spalek, A.; Mastalka, A. (Nuclear Research Inst., Rez, Czech.). Czech. J. Phys., 17: 711-14(1967).

The decay of ^{132}Cs was studied by means of Ge(Li) detectors and a magnetic beta-ray spectrometer. The energies and intensities of the transitions in ^{132}Xe and ^{132}Ba were determined. Of the decay schemes proposed hitherto, that of Johnson et al. [Phys. Rev., 138: B 520(1965)] was confirmed. (auth)

46746 DIRECT OBSERVATION OF HYPERFINE STRUCTURE IN PI MESIC X RAYS. Carrigan, R. A. Jr. (Carnegie-Mellon Univ., Pittsburgh); Sapp, W. W.; Shuler, W. B.; Siegel, R. T.; Welsh, R. E. Phys. Lett., 25B: 193-5(Aug. 21, 1967).

Appreciable hyperfine quadrupole effects were resolved for the first time in pi-mesic x rays through the use of a high-resolution detection system. The intrinsic quadrupole moment for tantalum determined by this method is 7.85 ± 0.46 barn, in agreement with results from other measurements. (auth)

46747 EFFECTS OF POLARIZATION IN COULOMB SCATTERING OF NEUTRONS WITH 4-MeV ENERGY BY NUCLEI OF COPPER, LEAD, AND URANIUM. Gorlov, G. V.; Lebedeva, N. S.; Morozov, V. M. Dokl. Akad. Nauk SSSR, 174: 60-3 (May 1, 1967). (In Russian).

The small-angle scattering of polarized neutron beams by heavy elements was studied to check on the applicability of the theoretical

expressions describing Coulomb scattering (J. Schwinger, Phys. Rev., 73: 407(1948)) at higher energies. To this end, an experimental study was made of the scattering of polarized neutrons with energy 4.00 ± 0.13 MeV at angles 2, 4, and 6°, by Cu, Pb, and U nuclei. The tests consisted of measuring the differential cross sections for elastic scattering in the plane perpendicular to the direction of polarization of the neutron beam, and also the total cross section for the interaction between the neutrons and the nuclei. The polarized neutrons were produced by a D–D reaction. The scattered neutrons were detected with four scintillation counters with stilbene crystals. The background ranged from 20% (U) to 40% (Cu) of the total number of detector counts in the presence of the scatterer. The differential cross sections were calculated from the data by taking into account multiple scattering for the concrete experimental conditions. In spite of the small polarization, noticeable scattering asymmetry was observed for all nuclei, thus indicating the presence of a polarizing ability of considerable magnitude and of negative sign in Cu, Pb, and U. This agrees with Schwinger's ideas with respect to Coulomb scattering of neutrons. The differential scattering cross section for neutron scattering in the unpolarized beam shows a noticeable rise in the cross section at 2° in the case of Pb and U, which is again in qualitative agreement with Schwinger's theory. The consequences of this agreement are discussed. (ATD)

46748 DECAY OF ^{178g,m}Lu. Tamura, Tsutomu (Japan Atomic Energy Research Inst., Tokyo). J. Phys. Soc. Jap., 23: 691–700(Oct. 1967).

The decay properties of ^{178g,m}Lu were studied by using a high resolution Ge(Li) γ-ray spectrometer, and the half-lives of the ground and isomeric states (~300 keV) were determined to be 30 ± 1 and 23 ± 1 min, respectively. The ground state (1^+) decays to the ground state (0^+) and to the 1st excited state (2^+, 93.1 keV) of ^{178}Hf with β rays of 2.05 MeV (60%, log ft = 6.6) and of 1.96 MeV (20%, log ft = 6.9), respectively. Weak β branches from ^{178g}Lu to the 1.272-MeV (4%), 1.407-MeV (5%), and 1.440-MeV (10%) levels in ^{178}Hf were also found. The isomeric state (7^-) populates two 8^- states at 1.147 MeV (85%, log ft = 5.35) and 1.479 MeV (15%, log ft = ft = 5.6). The γ rays observed at 332, 88.8 426, 326, 213.5, and 93.1 keV correspond to the transitions $8^- \rightarrow 8^- \rightarrow 8^+ \rightarrow 6^+ \rightarrow 4^+ \rightarrow 2^+ \rightarrow 0^+$ in ^{178}Hf. The configuration of the ground and isomeric states were considered as 1^+, $7/2$ + (404)p – $9/2$ + (624)n, and 7^-, $7/2$ + (404)p + $7/2$ – (514)n, respectively. (auth)

46749 ISOTOPIC COMPOSITION OF Xe, Kr, AND Ar EXTRACTED FROM THE OXIDE OF ^{244}Cm. Shukolyukov, Yu. A.; Ashkinadze, G. Sh.; Tolstikhin, I. N.; Trukhlyaev, P. S. At. Energ. (USSR), 22: 478–82(June 1967). (In Russian).

The relative and absolute yields of Xe isotopes during the spontaneous fission of ^{244}Cm were determined. It was found that the absolute yield is no more than $1/10$ of the Xe yield. The small difference of the isotopic ratio ^{38}Ar/^{36}Ar between atmospheric Ar and Ar released from the oxides of ^{244}Cm was detected. If the isotopes ^{38}Ar and ^{40}Ar are connected with the spontaneous fission of ^{244}Cm then each 100 events of ordinary spontaneous fission corresponds with the parallel formation of no more than two atoms of ^{38}Ar and no more than 4,000 atoms of ^{40}Ar. Additional experimental study of the possibility of the nuclear isotopes ^{38}Ar and ^{40}Ar is necessary. (tr-auth)

46750 RPC CALCULATIONS FOR K-FORBIDDEN TRANSITIONS IN ^{183}W EVIDENCE FOR LARGE INERTIAL PARAMETER CONNECTED WITH HIGH-LYING ROTATIONAL BANDS. Malmskog, Sven G. (AB Atomenergi, Studsvik, Sweden); Wahlborn, Sven. Nucl. Phys., A102: 273–85(1967).

Recent measurements have shown that the transitions de-exciting the 453-keV $7/2$, $7/2^-$ level in ^{183}W to the K = $1/2^-$ and $3/2^-$ bands are strongly retarded. The data for B(M1) and B(E2) are analyzed in terms of the RPC model (rotation + particle motion + coupling). With the $|\Delta K| = 1$(Coriolis) coupling, the K-forbidden M1 transitions proceed via admixtures of high-lying $9/2^-$ bands. A reasonable and unambiguous fit to the data is obtained by varying the strength of the coupling. Allowing for various uncertainties and corrections, one finds that the inertial parameter (the inverse of the coupling constant, i.e., $2\mathcal{I}/\hbar^2$) may have values between roughly 1 and 3 times the rigid-rotator value of $2\mathcal{I}/\hbar^2$, thus being unexpectedly large. Calculations with the $|\Delta K| = 2$ coupling are also performed and turn out not to give better agreement with experiment. (auth)

46751 THE Ω-FORBIDDEN DECAY OF THE 4.1 μs ISOMERIC STATE IN ^{170}Tm. Andreeff, A. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.); Kaestner, R.; Manfrass, P.; Bonitz, M.; Borggreen, J.; Sigurd Hansen, N. J. Nucl. Phys., A102: 241–52 (1967).

An isomeric state with a half-life of 4.12 ± 0.13 μs was found in the doubly odd nucleus ^{170}Tm. It decays by strongly retarded E1 transitions. The high hindrance factors of $\approx 10^8$ seem to be caused by the fact that the projections Ω of the angular momenta of the two odd nucleons are directed antiparallel in the initial state and parallel in the final states. The projection Ω_n for the neutron which undergoes the transition changes sign with respect to the projection Ω_p of the non-participating proton. This leads to the selection rule $|\Omega_{ni}| + |\Omega_{nf}| = 4 \leq L$ and thus threefold Ω-forbiddenness for the E1 transitions. (auth)

46752 NEUTRON-INDUCED FISSION CROSS SECTION OF ^{238}Pu. Barton, David M.; Koontz, Philip G. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. Phys. Rev., 162: 1070-6(Oct. 20, 1967). (LA-DC-8820).

The neutron-induced fission cross section of ^{238}Pu was found to be 2.08 ± 0.10 b at 1.0 MeV, 2.20 ± 0.11 b at 1.5 MeV, 2.23 ± 0.11 b at 3.0 MeV, and 2.67 ± 0.13 b at 14.9 MeV. The value at 3.0 MeV compares with 2.17 b as calculated from fission systematics. (auth)

46753 FAST-NEUTRON SCATTERING FROM THE 182, 184, AND 186 ISOTOPES OF TUNGSTEN. Lister, D. (Argonne National Lab., Ill.); Smith, A. B.; Dunford, Charles. Phys. Rev., 162: 1077–87(Oct. 20, 1967).

The differential cross sections for the elastic and the inelastic scattering of fast neutrons from ^{182}W, ^{184}W, and ^{186}W were experimentally determined at incident neutron energy intervals of ≲25 keV from 0.3 to 1.5 MeV. The excitation, by inelastic scattering, of states in ^{182}W was observed at 102 ± 5 and 327 ± 10 keV; in ^{184}W at 110 ± 5, 360 ± 10, 901 ± 10, 1003 ± 10, and 1120 ± 10 keV; and in ^{186}W at 121 ± 5, 398 ± 10, 738 ± 10, 863 ± 10, 942 ± 10, and 1035 ± 10 keV. The differential elastic and inelastic scattering cross sections were measured at 8 or more angles between 27 and 150° by means of a multiangle fast time-of-flight system. The resolution was sufficient to resolve most of the scattered neutron groups. The experimental results were interpreted in terms of a deformed optical model, coupled-channel direct interaction, and Hauser-Feshbach theory. Good agreement with measurement was obtained when the effects of resonance-width fluctuations and correlations were included. (auth)

46754 GAMMA-RAY SPECTRUM OF ^{99}Ru. Moss, G. A.; McDaniels, D. K. (Univ. of Oregon, Eugene). Contract AT(45-1)-1925. Phys. Rev., 162: 1087–97(Oct. 20, 1967). (RLO–1925–06).

The γ-ray spectrum resulting from the decay of 16.1-day ^{99}Rh to the excited states of ^{99}Ru was investigated using Ge(Li) solid-state detectors. The source, produced by the ^{99}Ru(p,n)^{99}Rh reaction using enriched ^{99}Ru metal, was found to emit a large number of γ rays. The energies of the stronger γ rays (with their relative intensities) are: 89.4 (100), 175.2 (7.6), 322.4 (21.7), 353.0 (107.1), 442.8 (5.7), annihilation radiation (30), 527.7 (132.0), 618.0 (13.1), 941.5 (5.0), 1292.1 (1.2), 1532.9 (1.8), 1572.4 (7.7), and 1970.3 (0.5) keV. A number of lines not previously reported have been found. Coincidence measurements and γ–γ directional correlations were performed using a 6-cc Ge(Li) detector in conjunction with a gain-stabilized NaI(Tl) spectrometer. The decay scheme was constructed with the aid of coincidence studies and high-precision γ-ray energy measurements. The spin of the 618.0-keV level was shown to be $1/2$, whereas the results of the 89.4–353.0 and the 175.2–353.0-keV correlations indicate either a $1/2$ or $3/2$ assignment to the 442.8-keV level. Attempts to find a theoretical model which represents the experimental data were made, incorporating the Nilsson model, the intermediate-coupling model of Bohr and Mottelson, and the core-excitation model of de-Shalit. (auth)

46755 PHOTONEUTRON CROSS SECTIONS FOR ^{90}Zr, ^{91}Zr, ^{92}Zr, ^{94}Zr, AND ^{89}Y. Berman, B. L.; Caldwell, J. T.; Harvey, R. R.; Kelly, M. A.; Bramblett, R. L.; Fultz, S. C. (Univ. of California, Livermore). Contract W-7405-eng-48. Phys. Rev., 162: 1098-1111(Oct. 20, 1967). (UCRL–70410).

Photoneutron cross sections, including σ[(γ,n) + (γ,pn)] and σ(γ,2n) for ^{90}Zr, ^{91}Zr, ^{92}Zr, ^{94}Zr, and ^{89}Y, and σ(γ,3n) for ^{94}Zr, were measured as a function of photon energy up to 30 MeV with a monoenergetic photon beam from positron annihilation in flight. The photon energy resolution varied from less than 300 keV at the lowest energy to 400 keV at the highest energies. The average neutron energy was determined simultaneously with the cross-section data. Nuclear information extracted from the data includes giant-resonance parameters, integrated cross sections, level densities, and threshold (and hence mass) values. In particular, it is found that a Lorentz-shaped curve gives an accurate representation of the total photoneutron cross section near the peak of the giant resonance, although in several cases there is important structure about 5 MeV above the giant resonance. The variation with neutron number and atomic weight of these quantities is studied for these nuclei near the N = 50 closed neutron shell. (auth)

46756 SPECTRUM OF HIGH-ENERGY GAMMA RAYS FOLLOWING THERMAL-NEUTRON CAPTURE BY ^{166}Er. Prestwich, W. V.; Cote, R. E. (Argonne National Lab., Ill.). Phys. Rev., 162: 1112-8(Oct. 20, 1967).

The thermal-capture γ-ray spectrum of the ^{166}Er(n,γ)^{167}Er reaction in a sample enriched in ^{166}Er(99.97%) was studied with a Ge(Li) pulse-height spectrometer. Some of the transitions are interpreted as populating states having excitation energies in good agreement with those of known states, and several additional levels with excitation energies less than 2 MeV are tentatively assigned on the basis of the data. The distribution of the radiative strength over final states previously assigned to a specific nuclear motion is compared with that expected for an initial state consisting of an s-wave neutron weakly coupled to the deformed target nucleus. (auth)

46757 CONVERSION-ELECTRON PARTICLE PARAMETERS IN THE DECAY OF ^{152}Eu, AND ^{154}Eu. Nasir, H. M.; Grabowski, Z. W.; Steffen, R. M. (Purdue Univ., Lafayette, Ind.). Contract AT(11-1)-1420. Phys. Rev., 162: 1118-24(Oct. 20, 1967). (COO-1420-133).

The internal conversion-electron particle parameters of several fast low-energy E2 transitions in the deformed nuclei ^{152}Sm and ^{154}Gd were determined by comparing the e^--γ directional correlations and γ-γ directional correlations displayed by the same sources. Special attention was paid to eliminating the effects of scattering in the source, and the corrections caused by the presence of extranuclear perturbations of the directional correlations were carefully studied. The results are: 0.122-MeV transition in ^{152}Sm: $b_2(E2,K) = 1.60 \pm 0.05$, $b_2(E2,L^-) = 1.03 \pm 0.05$; 0.245-MeV transition in ^{152}Sm: $b2(E2,K) = 1.72 \pm 0.07$; 0.344-MeV transition in ^{154}Gd: $b2(E2,K) = 1.57 \pm 0.13$; 0.123-MeV transition in ^{154}Gd: $b_2(E2,K) = 1.37 \pm 0.07$. The two particle parameters of the 0.122-MeV ground-state transitions in ^{152}Sm are about 15% lower and that of the 0.123-MeV ground state-transition in ^{154}Gd is 25% lower, than the theoretical predictions for finite-size nuclei. The particle parameters of the 0.245-MeV and of the 0.344-MeV transitions agree with the theoretical values within experimental errors. (auth)

46758 ALPHA-PARTICLE SCATTERING FROM EVEN TELLURIUM ISOTOPES. Leonard, R. F.; Stewart, W. M.; Baron, N. (Lewis Research Center, Cleveland). Phys. Rev., 162: 1125-9 (Oct. 20, 1967).

Angular distributions were measured for elastic and inelastic α scattering by isotopically enriched targets of tellurium-122, -124, -126, -128, and -130 by using the 42-MeV α beam of the Lewis 60-in. cyclotron. In each isotope, cross sections were measured for three excited states. These states were the one-phonon 2^+ quadrupole, the two-phonon 4^+, and the one-phonon 3^- octupole. Optical-model fits were made to the elastic scattering, and ambiguities in the optical potentials were investigated for a wide range of optical-model parameters. Such ambiguities are readily explained by assuming that the elastic scattering occurs primarily at the outer edges of the potential, and more penetrating particles are strongly absorbed. Inelastic scattering to one-phonon states was analyzed by using a distorted-wave Born-approximation (DWBA) calculation. Deformation parameters in agreement with previously measured values were obtained for all the one-phonon states. A number of other states having small cross sections were excited in each isotope. (auth)

46759 NEUTRON RESONANCE PARAMETERS OF THE ERBIUM ISOTOPES. Mughabghab, S. F.; Chrien, R. E.; Bhat, M. R. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 162: 1130-9(Oct. 20, 1967). (BNL-11483).

Neutron resonance parameters, s-wave strength functions, level densities, and radius parameters for ^{162}Er, ^{164}Er, ^{166}Er, ^{167}Er, and ^{168}Er were determined from total neutron cross-section measurements. Average cross-section measurements for ^{162}Er, ^{164}Er, and ^{167}Er were analyzed to determine neutron strength functions in the keV region, and the results are compared to those derived from the low-energy resonance-parameter data. A spin cutoff factor σ of 2.5 ± 0.8 is derived from a comparison of the level densities of ^{162}Er, ^{164}Er, and ^{167}Er. The thermal-neutron total cross sections were measured for ^{168}Er and ^{164}Er, and the paramagnetic scattering cross section for ^{168}Er was determined to be 26.1 ± 2.5 b. (auth)

46760 GAMMA TRANSITIONS FEEDING THE 4-msec, $13/2^+$ LEVEL OF ^{205}Pb IN THE DECAY OF ^{205}Bi. Murri, Richard L.; Vegors, S. H. Jr. (Idaho State Univ., Pocatello). Phys. Rev., 162: 1147-52(Oct. 20, 1967).

The decay of 14.5-day ^{205}Bi was reexamined, using delayed coincidence techniques, to establish which of the known γ-ray transitions feed the 4-msec, $13/2^+$ isomeric level in ^{205}Pb. The 987.8-keV transition in ^{205}Pb was used as a signature for the decay of the $13/2^+$ level. The data indicate that three transitions of energy 580.0, 1208.3, and 1552.2 keV, with respective relative intensities of 17.4, 7.6 ± 1.1, and 6.1 ± 0.8, are in delayed coincidence with the 987.8-keV transition. The sum of these transition intensities is in good agreement with the summed intensity of all transitions known to depopulate the isomeric level. In addition, prompt coincidence data indicate that the 550.1-keV transition feeds the 1043.7-keV level of ^{205}Pb. Evidence is presented that the 1043.7-keV level is $7/2^-$ instead of the previous assignment of $5/2^-$. (auth)

46761 NUCLEAR-RESONANCE-FLUORESCENCE AND GAMMA-SPECTROSCOPIC STUDIES IN ^{191}Ir. Schumacher, M.; Langhoff, H. (Franklin Inst., Swarthmore, Pa.). Contract AT(30-1)-3525. Phys. Rev., 162: 1153-8(Oct. 20, 1967). (NYO-3525-20).

A previous investigation of nuclear resonance fluorescence in ^{191}Ir was repeated with improved energy resolution by using a Ge(Li) detector. With ^{191}Pt as the source for the exciting radiation, two levels were excited. The energies were determined to be 539 ± 2 and 588 ± 2 keV. The cross sections for resonant scattering yield the following mean lifetimes: 539-keV level, $\tau = (14.4 \pm 1.1) \times 10^{-12}$ sec; 588-keV level, $\tau = (1.76 \pm 0.22) \times (g_2/g_1)(\Gamma_0/\Gamma)^2 \times 10^{-12}$ sec. The γ radiation emitted by the ^{191}Pt sources was studied using a 0.5-cm^3 Ge(Li) detector. The following transitions with $E_\gamma > 440$ keV were identified: 444.9, 456.8, 480.1, 494.9, 539.0, 568.8, 576.3, 583.5, 588.0, 623.9, 632.7, 658.7, 679.7, 747.7, 756.0, 762.2, 805.7, 853.0, and 935.6 keV. All these transitions were incorporated into a level scheme. The existence of previously suggested levels at 658.7 and 935.3 keV was confirmed. (auth)

46762 ISOBARIC ANALOG RESONANCES IN THE SCATTERING OF PROTONS BY ^{114}Cd. Hamburger, E. W.; Kremenek, J.; Cohen, B. L.; Moorehead, J. B.; Shin, C. (Univ. of Pittsburgh). Phys. Rev., 162: 1158-68(Oct. 20, 1967).

Elastic and inelastic scattering of protons from ^{114}Cd was studied for proton energies between 7 and 10 MeV. Resonances were identified at the following laboratory energies in MeV; numbers in parentheses give the orbital angular momentum in the elastic channel: 7.20 (0), 7.45 (2), [7.55 (2)], 7.68 (2), 7.85 (0), 8.00 (2), 8.58 (2), 9.15 (1), 9.30 (3), 9.71 (3). All are analogs of known states in ^{115}Cd, from the ground state to 2.5-MeV excitation. The elastic-scattering reduced widths are compared with the stripping reduced widths to the analog levels in ^{115}Cd. Agreement in relative value is found only for large reduced widths; the smaller components of the wave function seem to be different in the parent and in the analog states. The inelastic-scattering data indicate that the 0.48-MeV level has a very large overlap with the first excited state of ^{114}Cd (2^+), while a level near 2.0 MeV has a very large overlap with the 3^- state of ^{114}Cd at 1.95 MeV. Other states are also discussed. (auth)

46763 K X-RAY YIELDS OF PRIMARY ^{252}Cf FISSION PRODUCTS. Watson, R. L.; Bowman, H. R.; Thompson, S. G. (Univ. of California, Berkeley). Contract W-7405-eng-48. Phys. Rev., 162: 1169-74(Oct. 20, 1967). (UCRL-17518).

The yields of K x rays emitted by primary ^{252}Cf fission products have been measured with a high-resolution [0.82 keV full width at half-maximum (FWHM) at 26.25 keV] lithium-drifted silicon spectrometer. The most noteworthy feature in the systematics of the observed x-ray yields is the presence of a pronounced even-odd fluctuation associated with the atomic numbers Z = 52 through Z = 57, in which the odd-Z-product x rays are found to be more intense than the even-Z-product x rays by approximately a factor of 2. This effect is not observed in the light-fission-product region. The x-ray yields observed in this experiment are compared with the results of previous experiments in which the K x-ray yields were measured in association with the fission-fragment masses. Although general agreement is found in the over-all structural features, no evidence is seen in this study of the sudden drop in x-ray yield in the heavy-fission-product region corresponding to that which has previously been reported. The validity of the use of x-ray measurements as a method of determining the most probable charge distribution is examined in the light of the observed structure in the systematics of the x-ray yields. (auth)

46764 RECOIL RANGE DISTRIBUTIONS AS PROBES OF COMPOUND-NUCLEUS REACTIONS. Alexander, John M.; Simonoff, Gabriel N. (State Univ. of New York, Stony Brook). Phys. Rev., 162: 952-7(Oct. 20, 1967). (TID-23863).

The electrostatic collection of Dy ions recoiling in H_2 gas was examined. Range distributions for ^{149g}Tb production from Tb compound systems [(H.I.,xn) reactions] were measured. These range distributions, along with angular distributions measured formerly, indicate essentially isotropic neutron emission. Range distributions have been obtained for collimated recoils from the reaction ^{144}Nd(^{12}C,7n)^{149}Dy. The data are consistent with a Maxwellian distribution of recoil speeds in the cms. (auth)

46765 POLARIZED PROTONS AS NUCLEAR PROBES. Rosen, Louis (Los Alamos Scientific Lab., N. Mex.). Science, 157: 1127-34(Sept. 8, 1967).

A summary is given of a program carried out at LASL on the use of polarized beams of protons for probing nuclear structure. The experiments led to delineation of the spin–orbit part of the optical-model potential, and an improved unified description of the nucleon–nucleus interaction within the framework of the optical model. Data obtained by means of a six-parameter potential are correlated for essentially all complex nuclei and over an energy region ranging from several hundred keV to several tens of MeV for the following observables: polarization produced by elastic scattering, differential cross sections for elastic scattering, and reaction and total cross sections. None of the parameters varies with nuclear species, and only one varies with energy. Polarized protons were used to test the assumptions that reactions involving strong nuclear forces are invariant under parity and time-reversal operations. Comparisons of experimental cross sections with optical-model predictions are given for numerous cases of scattering. (S.F.L.)

46766 CHARGE EXCHANGE IN $^{91}Zr(d,p)^{92}Zr$. Moore, C. F. (Univ. of Texas, Austin). Contract AT(40-1)-2972. Phys. Lett., 25B: 408-9(Oct. 2, 1967). (ORO-2972-35).

Excitation functions for the reaction $^{91}Zr(d,p)^{92}Zr$ were measured in the energy region covering the thresholds for the $^{91}Zr(d,n)^{92}Nb$ to the analogues of the collective (0^+, ground), (2^+, 0.931 MeV), and (4^+, 1.492 MeV) states. An effect is observed which is attributed to isospin coupling. (auth)

46767 A NEW SPONTANEOUSLY FISSIONING ISOMER: ^{238}Am. Borggreen, J.; Gangrskii, Y. P.; Sletten, G.; Bjoernholm, S. (Univ. of Copenhagen). Phys. Lett., 25B: 402-4 (Oct. 2, 1967).

Bombardment of ^{239}Pu with 13–14 MeV protons leads to a spontaneously fissioning isomeric state with $t_{1/2} = 60 + 15$ μs assigned to ^{238}Am. Some systematic features are discussed. (auth)

46768 CORIOLIS COUPLING AMONG THE LOW-LYING POSITIVE-PARITY STATES IN ^{155}Gd. Bunker, M. E. (Los Alamos Scientific Lab., N. Mex.); Reich, C. W. Contract W-7405-eng-36. Phys. Lett., 25B: 396-9(Oct. 2, 1967). (LA-DC-8862).

Recent measurements indicate that the 86.5-, 105.3-, and 118-keV levels of ^{155}Gd have spin-parity assignments of $5/2^+$, $3/2^+$, and $(3/2 \cdot 5/2)^+$, respectively. A simple interpretation of these states in terms of Coriolis-coupled Nilsson orbitals is proposed. (auth)

46769 SEARCH FOR ELEMENT 102. Ghiorso, Albert; Silkeland, Torbjorn. Phys. Today, 20: No. 9, 25-32(Sept. 1967).

A comprehensive chronological review of investigations concerning element 102 is presented. Recent experiments at Berkeley have made it possible to clarify the complex history of the discovery of the element, and it is proposed that the old name "nobelium" be accepted. (S.F.L.)

46770 CONVERSION ELECTRONS IN THE DECAY OF ^{191}Os. Plajner, Z.; Brabec, V.; Dragoun, O.; Maly, L. (Nuclear Research Inst., Rez, Czech.). Czech. J. Phys., 17: 703-10(1967).

Internal conversion electrons in the decay of ^{191}Os were measured with a 30 cm double focusing spectrometer. The transition energies of (129.27 ± 0.07), 82.5, (46.90 ± 0.06), and (41.76 ± 0.02) keV are given together with the corresponding internal conversion line intensities. It was found that the mixture of the 129 keV transition was 87% M1 + 13% E2. The previously proposed decay scheme is supplemented by the 46.90 keV transition. (auth)

46771 INVESTIGATION OF THE REACTION $^{164}Dy(n,\gamma)^{165}Dy$. Markus, G.; Michaelis, W.; Schmidt, H.; Weitkamp, C. (Kernforschungszentrum, Karlsruhe, Ger.). Z. Phys., 206: 84-112-(1967).

The level structure of ^{165}Dy was investigated at the Karlsruhe research reactor using thermal neutron capture in ^{164}Dy. The target was Dy_2O_3 enriched to 92.71% ^{164}Dy. Neutrons were either monochromized by Bragg reflection from a lead crystal or transmitted through a bismuth single crystal filter. High-resolution measurements of the capture spectrum were performed by means of a Ge(Li) 5-detector pair spectrometer and a Ge(Li) anti-Compton assembly. A large number of new lines was observed. Cascade relations were studied by using several techniques: a double coincidence apparatus with 4 in. × 5 in. NaI(Tl) detectors, a coincidence system containing a scintillation detector and a 34 cm^3 Ge(Li)-diode as well as a two-parameter system involving the pair spectrometer (with NaI(Tl) as the primary detector) and a single 4 in. × 6 in. NaI(Tl) counter. In the framework of Nilsson's model and simple microscopic pictures of vibrational states, the results are consistent with the following spectroscopic interpretation: 0 keV, $1/2^+[633]$; 108.2 keV, $1/2^-[521]$; 184.3 keV, $3/2^-[512]$; 533.5 keV, $5/2^-[523]$; 538.6 keV, $1/2^+[633] + Q_{22}$; 570.3 keV, $5/2^-[512] + Q_{22} + 1/2^-[510]$; 573.6 keV, $3/2^-[521] + 1/2^-[521] + Q_{22}$; 1103.3 keV, $1/2^-[521] + Q_{22} + 3/2^-[521]$. For comparison preliminary results are given for the isotonic nucleus ^{169}Yb. (auth)

46772 STUDY OF HYPERFINE STRUCTURE INTERACTIONS IN THE 1274-keV LEVEL OF ^{204m}Pb BY $\gamma\gamma$ ANGULAR CORRELATION MEASUREMENTS. Lieder, R. M.; Delang, W.; Fleck, M. (Univ., Bonn). Z. Phys., 206: 29-48(1967). (In German).

The technique of differential $\gamma\gamma$ angular correlation measurements was applied to an investigation of the hyperfine interactions in the 1274-keV level of ^{204m}Pb. Using liquid sources, one obtains from the interaction with an external magnetic field of 35.2 kgauss a g-factor of + 0.055 ± 0.003, which is in agreement with earlier measurements. The investigation of the quadrupole interaction with the statistically oriented electric field gradient of ^{204m}Pb embedded in the lattice of metallic Thallium gave for the electric interaction frequency in the definition of Steffen and Frauenfelder $\omega_{01} = 2.23 \pm 0.15$ MHz. An additional frequency of $\omega_{02} = 6.91 \pm 0.15$ MHz was observed. This second frequency is probably caused by crystal imperfections. It vanished when the metal sources were annealed after the cyclotron irradiation. Finally, the perturbation of the $\gamma\gamma$ angular correlation of the 912–375 keV cascade was investigated by a combined interaction of the dipole moment of the intermediate 1274-keV state with an external magnetic field and its quadrupole moment with a statistically oriented static electric field gradient. Good agreement was obtained with the theory of Alder. (auth)

46773 ISOBARIC ANALOGUE STATES OBSERVED IN ^{125}I, ^{127}I, ^{129}I, AND ^{131}I. Foster, James Lee Jr. Austin, Tex., Univ. of Texas, 1967. 84p.

Thesis.

Isobaric analogue states were observed in proton elastic scattering from targets of ^{130}Te, ^{128}Te, ^{126}Te, and ^{124}Te. Comparison was made with the corresponding levels observed in (d,p) reactions. Resonance parameters, spectroscopic factors, and Coulomb energies were extracted. An optical-model contribution was added to the usual single level plus Coulomb scattering formalism in the data analysis. (Disser. Abstr.)

46774 THE INTERACTION OF FAST NEUTRONS WITH ORIENTED ^{165}Ho NUCLEI. Shelley, Edward George. Stanford, Calif., Stanford Univ., 1967. 203p.

Thesis.

The interactions of polarized and unpolarized neutrons with oriented and unoriented ^{165}Ho nuclei were investigated. A one-mole sample of polycrystalline holmium metal with a neutron transmission 0.175 and 0.160 at 8 and 15 MeV, respectively, was cooled to 0.34°K and magnetized to $M/M_m = 0.70$ parallel to the neutron beam. The first four "statistical" tensors were $B_1 = 0.55$ B_1 max; $B_2 = 0.25$ B_2 max; $B_3 = 0.06$ B_3 max; and $B_4 = 0.02$ B_4 max. The "deformation effect," $\Delta\sigma_{Def} = \sigma$(oriented) – σ(unoriented), was measured for unpolarized neutrons of 8 MeV and 15 MeV using the $^9Be(\alpha,n)^{12}C$ and $^3H(d,n)^4He$ reactions. $\Delta\sigma_{Def}$(8 MeV) = –38 ± 10 mb and $\Delta\sigma_{Def}$(15 MeV) = –140 ± 16 mb. The "spin-spin effect," $\Delta\sigma_{ss} = \sigma\uparrow\uparrow - \sigma\uparrow\downarrow$ where $\sigma\uparrow\uparrow$ and $\sigma\uparrow\downarrow$ are the total cross sections for neutron and nuclear spins parallel and antiparallel, respectively, was measured at $E_n = 7.85$ MeV using the polarized neutrons from the $^9Be(\alpha,n)^{12}C$ reaction at $\theta_{Lab} = 45°$ ($P_n = 0.34$); $\Delta\sigma_{ss}$(7.85 MeV) = +3 ± 13 mb. In addition, the neutron scattering angular distributions and neutron total cross sections for unpolarized neutrons at 8 and 15 MeV on unoriented ^{165}Ho nuclei were measured. The angular distributions were measured in 10° intervals from 20 through 160° with angular resolution varying between 10 and 20° FWHM. The total cross section measurements were σ_T(8 MeV) = 4.97 ± 0.11 barns and σ_T(15 MeV) = 5.27 ± 0.09 barns. All these data were explained in terms of the rotational optical model using a coupled-channel analysis in adiabatic approximation. The agreement with experiment is good and all existing data were found to be consistent with the accepted value for the nuclear deformation parameter $\beta = +0.3$. On the basis of the $\Delta\sigma_{ss}$ measurement, the following limits were established for the spin-spin potential: $-340 \leq V_{ss} \leq 540$ keV where $-V_{ss} F(r)\ \vec{\sigma} \cdot \vec{I}/I$ is the spin-spin term in the optical model with F(r) the standard Woods-Saxon shape. The results of the present work and other existing data were employed to select a set of optical parameters which varied smoothly over the neutron energy region between 0.35 MeV and 15 MeV. Both $\Delta\sigma_{Def}$ and $\Delta\sigma_{ss}$ were calculated over this entire energy range. The sensitivity of these effects to the choice of optical parameters was investigated. These investigations strongly suggest that $\Delta\sigma_{Def}$ will have a reversal of sign in the neutron energy region between 2 and 7 MeV. These investigations also suggest neutron energies where $\Delta\sigma_{ss}$ is expected to be large and where the interpretation of such an effect is least ambiguous. (Disser. Abstr.)

46775 COSMIC-RAY NEUTRONS NEAR THE EARTH AND INTERNAL CONVERSION STUDIES IN ^{133}Cs. Hendrick, Lynn Denson. Columbia, S. C., Univ. of South Carolina, 1966. 88p.
Thesis.

(I) The altitude distribution of cosmic-ray neutrons was measured from ground level up to 1175 feet using BF_3 detectors on a television antenna tower. Neutrons of about 1 keV energy were measured by surrounding the BF_3 counters with cadmium-coated polyethylene cylinders. The flux near the earth was found to depend strongly on the soil water content. The distribution of neutrons below 1 eV was found from the difference in count rates of bare and cadmium covered detectors and agrees with the result of a diffusion calculation. The neutron energy spectrum was investigated at the 45- and 1175-foot levels by counting with varying thicknesses of polyethylene surrounding the detectors but little difference between the spectra for the two levels was discernible. (II) The K/(L + M) internal conversion ratio for the 355-keV transition in ^{133}Cs was measured. The conversion electrons from this transition were detected in a lithium-drifted silicon detector maintained at 77°K. Coincidences were required between these electrons and the 81 keV gamma ray. The experimental value for the K/(L + M) ratio was found to be 4.27 ± 0.13. This indicates that the transition is predominantly electric quadrupole (E2) with a magnetic octupole (M3) admixture of no more than 2.5%, when the data are compared with available theoretical conversion coefficients. However, if an empirical Coulomb screening correction is applied to the theoretical M-shell coefficients, the measured K/(L + M) ratio indicates that the transition should be predominantly M3. The latter conclusion would not be consistent with the relative theoretical transition probabilities for the two possible multipolarities. (Disser. Abstr.)

46776 THE (n,α) REACTION INDUCED BY 14-MeV NEUTRONS. Yu, Yu-wen. Chicago, Illinois Inst. of Tech., 1966. 312p.
Thesis.

A systematic study was made of the (n,α) reaction induced by 14-MeV neutrons, including the mechanism of the reaction, the empirical trends, the shell effect and the experimental measurement of the total cross sections by the activation method. The latter required the development of a number of radiochemical separations of certain isotopes. A theoretical analysis of the (n,α) reaction was carried out based on the statistical model, with and without recourse to optical model parameters. Total cross sections of several isotopes of each element covering the entire range of elements were computed and the results discussed. A compilation was made of all reported (n,α) cross sections induced by neutrons of approximately 14 MeV energy. A study of these experimental values revealed certain pronounced trends which permitted the prediction of the (n,α) cross sections at 14 MeV of all of the isotopes of all elements with atomic numbers in the range $6 \leq Z \leq 94$. The cross sections are predicted using a semiempirical equation, of which the empirical part was adopted from Gardner's empirical equation for (n,p) reactions, and the theoretical part was derived from the point of view of the statistical model. The last part is a function only of the energy of the incident neutron, the Q-value, the pairing energy and the level density parameter. The Q-values for the (n,α) reactions were calculated using various nuclidic mass tables, and were compared with the experimental $Q_{n\alpha}$-values including some calculated from all published α-spectra on (n,α) reactions at 14 MeV. The results show that the values calculated from Wapstra's 1962 mass tables fit the experimental data best. The pairing energies of Cameron, Nemirovsky, Yamada, Dostrovsky, and Gardner were compared, the best values found being Gardner's values. The value of the level density parameter "a" depends on which level density equation is used. A general equation $W(U) = C\ U^{-n} \exp 2[a_n U]$ was tested by the spectrum of ^{59}Co(n,α)^{56}Mn reaction, and it was found that Erba's a-values fit best for n = 2, Lang's a-values agree with n = ¾ and the average value A/10 agrees well with n = 0. When Lang's a, Erba's a, Gardner's exponential "a" and average A/10 were compared with n = 0, it appears that at low Z the A/10 is best, and at high Z the exponential value is the best one. Shell effects of (n,α) reactions arising from various possible sources were studied, and a method to test for the effect of true proton shells was suggested. The total cross sections of the (n,α) reaction at 14.1 MeV were measured by the activation method and the following results were found: ^{40}Ar(34 ± 5 mb), ^{48}Ti(39 ± 6 mb), ^{50}Ti(9.4 ± 3 mb), ^{62}Ni(22 ± 3 mb), ^{206}Pb(2.7 ± 0.5 mb), ^{106}Cd(100 ± 25 mb), ^{112}Cd(2.4 ± 0.4 mb), ^{114}Cd(0.7 ± 0.1 mb), ^{116}Cd(0.5 ± 0.5 mb), ^{120}Sn(0.4 ± 0.4 mb). In addition, the following cross sections ^{110}Cd(n,p)(27 ± 5 mb), ^{111}Cd(n,p)(14 ± 1.4 mb)^{112}Cd(n,p)(11 ± 1.1 mb), ^{113}Cd(n,p)(7.9 ± 0.8 mb), ^{116}Cd(n,p)(0.2 ± 0.1 mb), ^{108}Cd(n,2n)(252 ± 40 mb), ^{116}Cd(n,2n)^{115m}Cd (730 ± 60 mb) and ^{116}Cd(n,2n)^{115g}Cd(857 ± 70 mb) were also measured. The separation chemistry of Ca, Fe, Pd, and Ag was developed. (Disser. Abstr.)

46777 SEARCH FOR POST ENDPOINT ELECTRONS AND FOR EVIDENCE OF NEUTRINO DEGENERACY. Tang, Seung Mun. Bloomington, Ind., Indiana Univ., 1966. 78p.
Thesis.

The nature of the low intensity spectrum tail which is observed at spectrometer settings corresponding to energies higher than that of the usual end point of a beta spectrum was examined in detail and a search was made for electrons whose energy might be higher than the decay energy in β^- decay. Such electrons might be derived from the absorption of neutrinos from the degenerate Fermi sea, the existence of which is implied by some modern cosmological theories. Because of the low counting rate and relatively high number of scattered electrons, datum points near the end point of a beta spectrum are not recorded with high accuracy by the usual technique of beta-spectroscopy. A technique was developed which provides a tremendous factor of discrimination against the recording of counts arising from scattering and background. By combining the electron energy sensitivity of a semiconductor detector with the momentum selectivity of a magnetic spectrometer, it was possible to demand that the recorded particles have the correct energy signature corresponding to the momentum setting of the magnetic field. The isotopes used for the investigation were ^{35}S, ^{147}Pm, and ^{63}Ni. They were chosen for the reasons that they have relatively low energy spectrum end points, statistical spectrum shapes, and there are no gamma radiations associated with their decays. Results of the ^{35}S and ^{147}Pm experiments confirm the validity of the measuring technique and show that the spectrum tail arises almost totally from background and instrumental scattering of electrons from the beta spectrum. Pulse-height peaks were observed, in the measurement of ^{147}Pm spectrum, at spectrometer settings corresponding to energies slightly higher than the energy of the spectrum end point determined by the F-K plot method. Because of the low counting rate and relatively poor statistics, energies corresponding to these peaks could not be exactly determined. Analysis of the data indicate that these peaks could arise from the finite resolution of the spectrometer as as well as from the absorption of degenerate neutrinos from the possible Fermi sea. The degenerate neutrino sea, if it at all exists, should have a Fermi energy, E_F, less than 750 eV provided that the Fermi sea consists mainly of degenerate neutrinos or if the number of degenerate anti-neutrinos is negligible compared to that of the degenerate neutrinos. Because of the finite resolution of the spectrometer and the inherent uncertainty in the end-point determination, no positive evidence of neutrino degeneracy was found in the ^{63}Ni experiments. The results, however, do set an upper limit of 250 eV for the Fermi level of the possible existing degenerate neutrino sea with the assumption that the fraction of occupied neutrino levels, X_+, is one. On the other hand, if X_+ is less than one, E_F could have a value greater than 250 eV. The measurements also set an experimental limit of 530 eV to the maximum extent beyond the end point at which there might be, for any reason, electrons emitted in beta decay with energies higher than the usual end point. This number, however, is limited by the inherent sensitivity of the detection system. In the case of ^{63}Ni, this corresponds to a counting rate of less than 6×10^{-4} percent of that at the peak of the spectrum. (Disser. Abstr.)

46778 NUCLEAR CHARGE AND MASS DISTRIBUTION IN FISSION: YIELDS AND GENETIC HISTORIES OF ^{121}Sn, ^{123}Sn, AND ^{125}Sn FROM THERMAL-NEUTRON FISSION OF ^{235}U. Erdal, Bruce Robert. St. Louis, Washington Univ., 1966. 163p.
Thesis.

The cumulative yields of the 27.06-hour ^{121}Sn, 127-day ^{123}Sn, and 9.67-day ^{125}Sn from thermal-neutron-induced fission of ^{235}U were measured using ^{89}Sr and ^{143}Ce as fission monitors. Proportional detectors were calibrated as a function of sample mass and beta energy using 4π-counting techniques. The results are: 0.0125 ± 0.0002%, 0.00188 ± 0.00007%, and 0.0116 ± 0.0004% for ^{121}Sn, ^{123}Sn, and ^{125}Sn, respectively. The yields of the ^{123}Sn isomers and of the ^{125}Sn isomers that are formed by beta decay of indium precursors were measured using timed separations of tin and indium. ^{89}Sr and ^{143}Ce were used as fission monitors. A method of rapidly separating essentially carrier-free tin and indium was developed which required less than 3 seconds. The method involved adsorption of tin on a cadmium sulfide-cellulose preparation. Tin samples were purified by a new rapid procedure that was developed. The results are as follows: 0.0183 ± 0.0014% for the 40.08-minute ^{123}Sn, about 0.013% for the 127-day ^{123}Sn, 0.023 ± 0.005% for the 9.52-minute ^{125}Sn, and 0.001% to 0.004% for the 9.67-day ^{125}Sn. The half-lives of the previously undiscovered ^{125}In isomers were determined to be 2.5 ± 0.5 seconds and 17.8 ± 2.7 seconds. The half-life of the short-lived ^{123}In isomer was determined to be 6.0 ± 0.7 seconds, a value somewhat shorter than the previously reported value of 10 ± 2 seconds. The results of the yield measurements indicate that there is no structure on the light

side of the heavy mass peak of the mass-yield curve. The results also indicate that the fission fragments that lead to the fission products in the mass number 121 to 128 region are somewhat rich in protons compared to the fissioning nucleus. This is contrary to the observation that the high-yield fragments are proton-poor. The results also indicate that the ratio of the independent yields of the high-spin ($11/2^-$) to the low-spin ($3/2^+$) states of ^{125}Sn is as large or larger than the ratio previously reported for ^{131}Te isomers and ^{133}Te isomers. The large ratio implies that the tin fragments which lead to the ^{125}Sn isomers acquire a large amount of angular momentum at scission. (Disser. Abstr.)

46779 DIRECT AND ABSOLUTE MEASUREMENTS OF AVERAGE YIELD OF NEUTRONS IN THERMAL FISSION OF ^{235}U AND SPONTANEOUS FISSION OF ^{252}Cf. De Volpi, Alexander. Blacksburg, Va., Virginia Polytechnic Inst., 1967. 103p.

Thesis.

Absolute measurements, using the manganese bath technique and prompt-neutron coincidence calibration of fission counters, were carried out to obtain independent evaluations of the total yield of neutrons in thermal fission of ^{235}U[$\bar{\nu}(^{235}U)$] and spontaneous fission of ^{252}Cf[$\bar{\nu}(^{252}Cf)$]. In this experiment, the neutron-fission coincidence phase was used to calibrate only the fission counter efficiency; this calibrated fission counter was then inserted in a large manganese bath where the fission rate and neutron rate were simultaneously monitored. The absolute efficiency of the manganese bath was determined with the aid of a series of supplementary experiments, including frequent comparison of absolute 4π beta–gamma coincidence counting with the liquid radio-assay system. The over-all neutron detection efficiency relies heavily on the published manganese/hydrogen cross-section ratio, now known to about 0.3%. Corroboration of the neutron efficiency is found by obtaining a source rate of $1.185 \pm 0.007 \times 10^6$ neutrons/sec for the U. S. National Bureau of Standards secondary source (NBS-II), which has a most recent best value $1.180 \pm 0.012 \times 10^6$ neutrons/sec. It is believed that this method is free of certain possible systematic errors, namely a priori assumptions with regard to the fission neutron spectrum; calibration of a detector whose sensitivity is comparatively neutron-energy dependent; and angular anisotropy of neutron emission in flat-foil fission chambers. Examination of the literature and of data obtained from specific experiments indicates that this latter problem may be responsible for the relatively large scatter compared to the reported precision of published values of the ^{235}U fission cross section and $\bar{\nu}$. The results of this experiment, $\bar{\nu}(^{235}U) = 2.407 \pm 0.03$ neutrons/fission and $\bar{\nu}(^{252}Cf) = 3.750 \pm 0.028$ neutrons/fission, are highly consistent with weighted averages determined by international data compilation centers. (Disser. Abstr.)

46780 COULOMB EXCITATION OF COLLECTIVE NUCLEAR STATES IN EVEN–EVEN NEODYMIUM AND GADOLINIUM NUCLEI. Burginyon, Gary Alfred. New Haven, Yale Univ., 1967. 209p.

Thesis.

Collective states in ^{154}Gd, ^{158}Gd, ^{142}Nd, ^{144}Nd, ^{146}Nd, ^{148}Nd, and ^{150}Nd were populated through Coulomb excitation with oxygen ions ranging from 42 to 72 MeV. The de-excitation gamma radiation from thick metal targets was detected singly, in coincidence with back-scattered oxygen ions, and in some cases in coincidence with other cascading gamma rays. New states were found in ^{148}Nd and ^{150}Nd, and a number of previously unmeasured reduced transition probabilities are presented. The data are compared to predictions of the various phenomenological collective models with particular attention devoted to the transitional nuclei, ^{154}Gd and ^{150}Nd, which exhibit large deviations from the simplest adiabatic form of these models. An attempt is made to account for deviations in the ground-state-band level spacings from the $I(I+1)$ rule of the axially symmetric rotor model by a first-order perturbation treatment of band mixing with the beta and gamma bands. Mixing with the gamma band accounts for only about 5% of the observed deviations in ^{154}Gd and ^{150}Nd but for about 50% of the small deviations in ^{158}Gd. Mixing with the beta band accounts for approximately 29% and 51% of the observed deviations in ^{150}Nd and ^{154}Gd. These results suggest the possibility of contributions from other mechanisms which is discussed, or the need for a more exact treatment of band mixing. Other models which treat the rotation-vibration interaction in a more exact manner do provide a better overall fit to the data, but some discrepancies remain and are discussed. (Disser. Abstr.)

46781 THE MEASUREMENT OF STATIC ELECTRIC QUADRUPOLE MOMENTS OF EXCITED NUCLEAR STATES BY COULOMB EXCITATION. Stokstad, Robert Grandin. Pasadena, Calif., California Inst. of Tech., 1967. 137p.

Thesis.

Measurements of the probabilities for Coulomb excitation of the first 2^+ excited states in ^{114}Cd, ^{116}Cd, ^{126}Te, and ^{128}Te were made with ^{4}He, ^{12}C and ^{16}O ions. The deviations observed in a comparison of the experimental data with the predictions of first-order perturbation theory are interpreted in terms of the static electric quadrupole moments, Q_2, of the first 2^+ excited states of the nuclei. The deduced values of Q_2 are found to lie in the ranges $-0.44 \geq Q_2 \geq -0.97$, $-0.67 \geq Q_2 \geq -1.18$, $-0.16 \geq Q_2 \geq -0.50$ and $-0.01 \geq Q_2 \geq -0.40$ e · 10^{-24} cm^2 for ^{114}Cd, ^{116}Cd, ^{126}Te, and ^{128}Te, respectively. The deduced values of Q_2 for ^{114}Cd and ^{116}Cd are found to be surprisingly large when compared with the predictions of the vibrational model. (Disser. Abstr.)

46782 DECAY PROPERTIES OF NEUTRON-DEFICIENT ISOTOPES IN THE XENON–BARIUM MASS REGION. D'Auria, John Michael. New Haven, Yale Univ., 1967. 251p.

Thesis.

Heavy ion induced reactions were utilized in the search for and study of the presence of isomerism in ^{125}Ba. Standard radiochemical techniques were used to separate the neutron deficient reaction products formed from the reaction of ^{12}C, ^{14}N, and ^{16}O heavy ions with targets of natural In and Sb. The radioactive decay of ^{125}Ba as well as surrounding nuclides such as ^{121}Cs, ^{123}Cs, ^{125}Cs, ^{126}Cs, ^{123}Xe, ^{125}Xe, ^{122}Ba, ^{124}Ba, ^{126}Ba, and ^{127}Ba were studied, exploiting various techniques of nuclear spectroscopy. The half-lives of the isomeric levels in ^{125}Ba were determined to be 3.0 ± 0.5 and 8.0 ± 1.5 min. The maximum energy available for beta decay was 4.6 ± 0.25 and 5.5 ± 0.3 MeV, respectively, with an isomeric level separation deduced to be 900 ± 300 keV. Since the three min component was populated in greater yield over the eight min component, by way of the compound nucleus de-excitation process, it was assigned as the high spin state ($9/2-$). These spin assignments of ($9/2-$) and ($1/2+$) for the isomeric pair are shown to be consistent with the genetically related as well as with the surrounding nuclides. A tentative decay scheme is presented. New neutron deficient isotopes ^{122}Ba, ^{124}Ba, ^{121}Cs possess half-lives of 12 ± 1, $2.5 - 5$, and 2.0 ± 0.5 minutes, respectively, and several characteristic gamma rays. The isotope, ^{123}Cs, decays with a half-life of 5.6 ± 0.2 min to the ground state and first excited state at 98 keV of ^{123}Xe. Half-lives and gamma ray energies were confirmed, and additional gamma rays obtained for the decay of isotopes ^{126}Ba, ^{126}Cs, ^{127}Ba, ^{125}Xe, and ^{123}Xe. Tentative decay schemes are presented for these isotopes. In the presence of isomerism of ^{125}Ba with the high spin state as the ground state are interpreted in the framework of the Kumar–Baranger picture, then this nuclide possesses a deformation parameter (β) of about 0.15, based on the predicted level inversion of the ($11/2-$, $9/2$) and ($3/2+$, $1/2+$) levels. This viewpoint is supported by a presentation of the systematic energy level trends of the odd-A neutron deficient Te, Xe, and Ba isotopes. The transition between a spherical and aspherical nuclear shape is discussed in the light of the observable nuclear properties of both odd-N and even-even isotopes. Information is also presented on the search for delayed proton emission from the isotope ^{17}Ne. (Disser. Abstr.)

46783 THE CHEMICAL BEHAVIOR OF ^{121}Sn, ^{125}Sn, ^{127}Sn, AND ^{128}Sn FORMED BY THE THERMAL-NEUTRON FISSION OF ^{235}U. Brown, Larry Clyde. St. Louis, Washington Univ., 1966. 77p.

Thesis.

The distributions of four tin fission products, ^{121}Sn, ^{125}Sn, ^{127}Sn, and ^{128}Sn, between Sn(II) and Sn(IV) oxidation states were measured. The data show that ^{121}Sn is formed mainly in the +4 oxidized state, whereas, ^{125}Sn, ^{127}Sn, and ^{128}Sn are formed mainly in the +2 oxidation state. The oxidized condition of ^{121}Sn is correlated to formation of the nuclide by beta decay; whereas, the reduced conditions of ^{125}Sn, ^{127}Sn, and ^{128}Sn are ascribed to direct formation in the nuclear fission process. The results for ^{125}Sn, ^{127}Sn, and ^{128}Sn disagree with the fractional independent yields predicted by the empirical approach to nuclear charge distribution and seem attributable to nuclear shell effects in which the fissioning nucleus shows a definite preference for $Z = 50$ in the formation of the heavy fragment. (Disser. Abstr.)

46784 ISOBARIC-SPIN ANALOGUE RESONANCE AND NUCLEAR SPECTROSCOPY IN ODD-PALLADIUM ISOTOPES. Hayakawa, Shun-Ichiro. Tallahassee, Florida State Univ., 1966. 150p.

Thesis.

The investigation of isobaric analog states of the odd palladium isotopes ^{103}Pd, ^{105}Pd, ^{107}Pd, and ^{109}Pd was performed by observing these states as compound-nucleus resonances through proton elastic scattering and (p,n) measurements with targets of separated isotopes of ^{102}Pd, ^{104}Pd, ^{106}Pd, and ^{108}Pd. The energy-level separations, proton partial widths, and total widths of the isobaric analog resonances were obtained through analysis of the proton elastic scattering data by using a Coulomb plus single-level for-

mula. The resonance energies were determined within an accuracy of ±15 keV. The proton partial widths and the total width of the resonances were obtained within an accuracy of 10 to 25%. The values of the proton partial widths varies from 1.5 to 15.2 keV. The total widths of the resonances were from 20 to 60 keV. Twelve resonances were analyzed in these isotopes. The energy spacings and l-values of these sharp resonances observed in proton elastic scattering had the expected agreements with the low-lying states of odd palladium isotopes. Therefore, these resonances were identified as isobaric analog states of odd palladium isotopes. An effort was made to obtain spectroscopic factors in isobaric analog resonances. The spectroscopic factors of the observed analog resonances were calculated by two different methods. They were compared with the spectroscopic factors of the corresponding low-lying states of the odd palladium isotopes, which were obtained through the (d,p) reaction. The Coulomb displacement energies were obtained through the analysis of analog resonances. There is no evidence for deformation or pairing effects within the accuracy of this analysis. Since there were no (d,p) data available for the ^{102}Pd target the experiment was performed in order to compare the low-lying states of ^{103}Pd with the analogue states which were observed in proton elastic scattering measurements. Angular distributions of proton groups were measured and were analyzed with the help of direct reaction theory. Ten low-lying levels of ^{103}Pd were identified through the analysis. Further identification of higher levels were hindered due to the heavy impurities of other Pd isotopes in the target. (Disser. Abstr.)

Nuclear Theory

Refer also to abstracts 46147, 46449, 46502, 46660, 46685, 46706, 46715, 46750, 46764, and 46765.

46785 (BNL-11722) HIGH ENERGY SCATTERING FROM NUCLEI. Wilkin, C. (Brookhaven National Lab., Upton, N. Y.). Aug. 1967. 77p. Dep. CFSTI.

A lecture is given on the theory of small-angle elastic scattering of high-energy nucleons on light-weight nuclei and also on inelastic scattering in which low-lying states are excited. A review is also given of high-energy electron scattering. (S.F.L.)

46786 (IAE-1266) VOZBUZHDENIE VIBRATSIONNYKH UROVNEI CHETNO-CHETNYKH YADER PRI AL'FA-RASPADE. (Excitation of Vibrational Levels of Even-Even Nuclei in α Decay). Nosov, V. G. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). 1966. 49p. (In Russian). Dep.

The theory of α decay of nonspherical nuclei which was previously developed by the author is generalized to cover the case when the states arising in a daughter nucleus are vibrational in nature. A comparison with experimental data for even-even nuclei is claimed to furnish important information on the static and dynamic characteristics of heavy nuclei. A number of equations are derived for excitation of vibrational levels in nonspherical nuclei, octupole oscillation of nonspherical nuclei, fully symmetrical (beta) oscillations, quadrupole (gamma) oscillations, and phase transformations of spherical into nonspherical nuclei. The course of zero-amplitude oscillations of octupole deformation was determined for nuclei with nonspherical equilibrium configuration from the negative evenness excitation levels. An evaluation is given of the probability of occurrence of two-background octupole excitation which has not yet been discovered experimentally. In the case of gamma oscillation, an explanation is given of the nature of the prohibition due to which the population of the corresponding single-background level in α decay was not observed experimentally. The probability of this process was computed. The field of nuclei with the spherical equilibrium form is examined. The course of quantum fluctuations in quadrupole deformation is reported to be in agreement with the data on electrical quadrupole transitions between the corresponding vibrational levels. The internal probability of the formation of an α particle at the point of transformation of nonspherical into spherical nuclei is said to increase by an order of magnitude. This is seen as evidence of more profound changes in the properties of the energy spectrum of a nucleus in the course of the phase transition process described earlier. Quantum fluctuation of the various transformations of the nucleus in the vicinity of the phase transition point is considered possible. (JPRS)

46787 (NP-16901) NOTAS DE FISICA NUCLEAR. PARTE "A." CUADERNO NO. 1. CAPITULO II. DESINTEGRACION RADIOACTIVA. (Reports on Nuclear Physics. Part A. Quarterly No. 1. Chapter II. Radioactive Decay). Bosch, Horacio E. (Instituto de Investigacion Aeronautica y Espacial, Buenos Aires (Argentina). Laboratorio de Radiaciones y Alta Atmosfera). Dec. 1966. 79p. (In Spanish).

A student's notebook on radioactive decay is presented. The topics discussed are decay laws, radioactive chains and natural radioactive families, application of the formulas of radioactive chains to the case of nuclear reactions, application of the radioactive formulas to the calculation of activities produced in nuclear reactions, application of radioactive formulas to the case of fission, accumulation of stable products, graphic methods for the determination of accumulation and activity decay and approximation methods for the calculation of activity accumulation. (J.S.R.)

46788 (NP-16902) NOTAS DE FISICA NUCLEAR. PARTE "A." CUADERNO NO. 1. CAPITULO I. ESTRUCTURA ATOMICA Y NUCLEAR. (Reports on Nuclear Physics. Part A. Quarterly No. 1. Chapter I. Atomic and Nuclear Structure). Bosch, Horacio E. (Instituto de Investigacion Aeronautica y Espacial, Buenos Aires (Argentina). Laboratorio de Radioaciones y Alta Atmosfera). Dec. 1966. 39p. (In Spanish).

A student's notebook on atomic and nuclear structure is presented. It is an introduction to nuclear physics. The topics discussed are atomic structure, transitions between electron shells, Auger effect, nuclear structure, impossibility of the existence of electrons in the nucleus, elementary particles, conservation laws in particle decay, forces between elementary particles, bosons, fermions, formation of hypernuclei, and mesic atoms. (J.S.R.)

46789 (NP-16903) NOTAS DE FISICA NUCLEAR. PARTE "A." CUADERNO NO. 1. CAPITULO III. MASAS ATOMICAS Y NUCLEARES. (Reports on Nuclear Physics. Part A. Quarterly No. 1. Chapter III. Atomic and Nuclear Mass). Bosch, Horacio E. (Instituto de Investigacion Aeronautica y Espacial, Buenos Aires (Argentina). Laboratorio de Radiaciones y Alta Atmosfera). May 1967. 108p. (In Spanish).

A student's workbook is presented with a discussion of atomic and nuclear masses. The topics discussed are classification and nomenclature, physical and chemical atomic mass scales, relation between mass and energy units, unification of scales, tables of nuclides, energetics of radioactive decay, mass differences between neutron and hydrogen atoms, packing fractions, energy of separation of a particle, and isotopic abundance of the elements. (J.S.R.)

46790 (UCRL-17724) AVERAGE NUCLEAR PROPERTIES. Myers, W. D.; Swiatecki, W. J. (California Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1967. Contract W-7405-eng-48. 6p. (CONF-670910-3). Dep. CFSTI.

From International Conference on Nuclear Structure, Tokyo, Japan.

A simple nuclear model which is intended to describe all average nuclear properties that do not depend on the discreteness of the nucleons is outlined. The Thomas-Fermi treatment is used, and the nucleon-nucleon interaction is assumed to be a phenomenological Yukawa force. (D.C.W.)

46791 (BNL-tr-122) INTERNAL CONVERSION COEFFICIENTS OF γ RADIATION IN THE K AND L SHELLS. Sliv, L. A.; Band, I. B. Translated by Stephen J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from Zh. Eksp. Teor. Fiz., 31: 134-6(1956). 17p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

More extensive calculations of K-shell and L-subshell conversion coefficients were made. The physical assumptions that were made for the calculations are outlined together with the mathematical formulation. (D.C.W.)

46792 POLARIZATION PHENOMENA IN THE DEUTERON STRIPPING REACTION WITH SPIN-ORBITAL DISTORTION. Cejpek, J. Ukr. Fiz. Zh., 12: 1233-40(Aug. 1967). (In Russian).

A method is proposed which permits one to determine separately the influence of the polarization and alignment of incident deuterons on the angular distribution of the stripping reaction, when the spin-orbital distortion is taken into account. The method is suitable for any value of the orbital momentum of a captured particle and also for other reaction mechanisms, where the alignment of the deuterons can exert influence on the angular distribution. For a particular case in which the stripped-off particle is captured with zero orbital momentum into the target nucleus, a relation between the polarizations of the proton and the final nucleus is derived. In all calculations the spin-orbital distortion is taken into account exactly. (auth)

46793 SELECTION RULES FOR THE POLARIZATIONS AND ANGULAR CORRELATIONS IN THE ANOMALOUS STRIPPING REACTION. Cejpek, J. (Purkine Univ., Brno). Ukr. Fiz. Zh., 12: 1241-6(Aug. 1967). (In Russian).

For a special mechanism of the stripping reaction (d,p) accompanied by Coulomb excitation of the target nucleus, the azimuthal asymmetry of the angular distribution in the reaction with oriented deuterons, the polarization of protons in the reac-

tion with unpolarized initial particles, and the statistical tensors for the final nucleus were found. Non-zero polarization of the reaction products was obtained even for the capture of a neutron with zero orbital momentum, the spin-orbital distortion being neglected. Conditions for the angular correlations (d,p γ) to be anisotropic were determined. It is shown that they are generally less restrictive than in the usual stripping. (auth)

46794 SPIN POLARIZATION EFFECT ON THE FAST ALLOWED BETA TRANSITIONS BETWEEN DEFORMED ODD-MASS NUCLEI. Boehnacki, Z.; Ogaza, S. (Univ. of Copenhagen). Nucl. Phys., A102: 529-33(1967).

The influence of the spin polarization on transition rates of allowed unhindered beta transitions between odd-mass deformed nuclei is considered. The effect is found to account for the experimentally observed retardations. (auth)

46795 DESCRIPTION OF ELASTIC SCATTERING AND POLARIZATION OF SPIN-HALF PARTICLES BY THE COMPLEX ANGULAR MOMENTUM METHOD. Spencer, M. B. (Univ. of Auckland, N. Zealand). Nucl. Phys., A102: 545-53(1967).

Formulae for the cross section and polarization are obtained from the usual diffraction model assumptions using a mathematical technique arising from the use of complex angular momentum. The models used allow for smearing at the nuclear surface, and the final formulae obtained are compared with experimental measurements. (auth)

46796 TWO-BODY MATRIX ELEMENTS FROM A MODIFIED SURFACE DELTA INTERACTION. Glaudemans, P. W. M. (Fysisch Laboratorium der Rijksuniversiteit, Utrecht); Brussaard, P. J.; Wildenthal, B. H. Contract W-7405-eng-26. Nucl. Phys., A102: 593-601(1967). (ORNL-P-3139).

The addition of a T-dependent but J-independent term to the surface delta interaction greatly improves the agreement between the values of the two-body matrix elements calculated from this interaction and the corresponding values obtained both from empirical fits to level energies and from a realistic (Hamada-Johnston) interaction. This is shown for 1d-2s and 1f-2p configurations. The use of this modified surface delta interaction as a shell-model residual interaction produces good agreement between the calculated and experimental energies of many-nucleon configurations. In particular, total binding energies and the energy spacings between levels of different isospin are fitted much better than is possible without the use of the extra T-dependent term. (auth)

46797 BINDING-ENERGY CALCULATIONS FOR FINITE NUCLEI. Nickel, B. G. (Univ. of Saskatchewan, Canada); Tomusiak, E. L.; Peierls, R. E. Nucl. Phys., A102: 655-66 (1967).

A method for computing nuclear binding energies without making recourse to the full Brueckner reaction matrix is discussed. The view presented is that with the aid of the Moszkowski-Scott technique ordinary Rayleigh-Schrodinger theory may suffice in handling repulsive core potentials provided approximate self-consistency is maintained. Our arguments are supported by results obtained in applying the method to ^{16}O using two simple hard-core potentials. (auth)

46798 THEORY OF NUCLEAR MATTER. Bethe, H. A. (Cornell Univ., Ithaca, N. Y.). pp 39-57 of Proceedings of the 1966 Midwest Conference on Theoretical Physics, Indiana University, May 20-21, 1966. Lichtenberg, D. B. (ed.). Bloomington, Ind., Indiana University, 1966.

See CONF-660545.

A review is given of the basic principles of the theory of nuclear matter. The scattering matrix for 3-body scattering is calculated, and the binding energy per nucleon in nuclear matter is calculated on the basis of a 3-body interaction. A brief review is given on calculations of the density distribution and energy at the surface of a large but not infinite nucleus. (S.F.L.)

46799 NUCLEAR THREE BODY PROBLEM. Amado, R. D. (Univ. of Pennsylvania, Philadelphia). pp 70-93 of Proceedings of the 1966 Midwest Conference on Theoretical Physics, Indiana University, May 20-21, 1966. Lichtenberg, D. B. (ed.). Bloomington, Ind., Indiana University, 1966.

See CONF-660545.

The three-body nuclear problem is discussed in terms of separable interactions or separable potentials whereby the three-body equations can be arranged to give equations which, after a partial wave decomposition, are integral equations in just one variable. It is shown that simple s-wave interactions go a long way in solving the three-nucleon problem. It is suggested that application of tensor forces, hard cores, and d-waves may help to understand off-energy-shell properties of the force and three-body forces. (S.F.L.)

46800 POLARIZED SPIN-ONE PARTICLES. Darden, S. E. (Univ. of Notre Dame, Ind.). Contract Nonr-1623(05). Amer. J. Phys., 35: 727-38(Aug. 1967).

A simplified treatment of polarization effects in scattering of spin-one particles is presented. The analogy between spin moments and electric multipole moments is exploited. Elementary physical arguments illustrating the mechanism of polarization are given for two specific interactions. (auth)

46801 COLLECTIVE MODEL OF THE GIANT RESONANCES. Huber, Max G. (Duke Univ., Durham, N. C.). Amer. J. Phys., 35: 685-701(Aug. 1967).

The collective model of the giant resonances is described. The dipole vibrations are discussed in greater detail and applied to both spherical and deformed nuclei. In a consistent expansion of the model the collective-charge vibrations are coupled to the low-energy nuclear-surface vibrations. The implications of this dynamical treatment on the photoabsorption cross section are discussed and are compared with experimental data. The properties of other kinds of collective motions such as spin waves and spin-isospin waves are reviewed. Finally, the connection between the collective picture of charge vibrations and the shell-model treatment of the giant resonances is pointed out. (auth)

46802 LOCUS OF MAGNETIZATION FOR A SPIN-1 QUADRUPOLAR NUCLEUS. Albert, Richard H. (Mobil Oil Corp., Princeton, N. J.). Amer. J. Phys., 35: 702-4(Aug. 1967).

The path traced out by the terminus of the magnetization vector for a spin-1 nucleus subjected to a nonvanishing electric-field gradient is calculated quantum mechanically. Certain special combinations of angular momentum operators are used to simplify the work. (auth)

46803 NUCLEAR FORCES IN MANY-BODY SYSTEMS. Kiang, D.; Nogami, Y. (Dalhousie Univ., Halifax, Nova Scotia). Nuovo Cim. (10), 51A: 858-61(Oct. 1, 1967).

The problem of whether the same nucleon-nucleon potential as determined for a pair of nucleons isolated in vacuum can be employed in a many-body system like a nucleus or nuclear matter is considered. The problem was previously examined in perturbation theory by Osada and Takeda, taking a symmetrical scalar-meson field as an example; conventional and meson theoretical calculations yielded the same result when three-body forces were excluded from the conventional one. It is shown that a model which has nonvanishing three-body force can be constructed in which the results of calculations such as those of Osada and Takeda agree only when the three-body force is included. (L.B.S.)

46804 SEPARATION OF SURFACE- AND VOLUME-VIBRATIONS IN QUADRUPOLE-DEFORMED NUCLEI AND CONSEQUENCES ON ISOTOPE SHIFTS. Weiguny, Achim (Univ., Freiburg i. B.). Z. Phys., 206: 406-14(1967).

Starting from the complete Hamiltonian for a system of N nucleons, the problem of separating volume and surface vibrations in permanently deformed nuclei is investigated. The required "volume" variable which allows this separation turns out to be the mean square distance of a nucleon with reference to the center of mass. The investigation confirms the concept of pure surface vibrations, as is used in the rotation-vibration model of Flssler and Greiner, and leads to a theoretical argument in favor of Fradkin's idea of "compressibility under deformation," which is based upon experimental evidence in calculating isotope shifts in deformed nuclei. (auth)

46805 APPLICATION OF HIGH-RESOLUTION OPTICAL SPECTROSCOPY TO THE STUDY OF QUADRUPOLE MOMENTS OF EVEN-NUMBER RADIOISOTOPES. Gagne, Jean-Marie (Ecole Polytechnique, Montreal). Appl. Opt., 6: 1649-54(Oct. 1967). (In French).

By means of high resolution optical spectroscopy, the nuclear quadrupole moments of radioactive or stable nuclides with even atomic number in the heavy elements region were obtained. The main conditions applicable to the method are discussed and summarized. (auth)

46806 POLARIZATION EFFECTS IN THE (d,p) STRIPPING REACTION. Van Rij, W. I. (Univ. of Auckland, New Zealand). Nucl. Phys., A102: 286-94(1967).

The $l_n = 0$ (d,p) stripping reaction in DWBA is studied as a means of investigating the incident and exit channel optical potentials. Emphasis is put on the polarization effects which are particularly dependent on spin-dependent distortion. Some new results for the polarization of the residual nucleus are given. Experiments for testing the theory are suggested. (auth)

46807 SEMISCHEMATICAL MODEL OF THE COUPLING OF THE PARTICLE–HOLE AND 2 PARTICLE–2 HOLE STATES IN THE CONTINUUM. Balashov, V. V.; Kabachnik, N. M. (Moscow Univ.). Phys. Lett., 25B: 316-18(Sept. 18, 1967).

Two-particle, two-hole states are introduced to describe the splitting of the dipole resonance. The technique is applied to ^{16}O. (auth)

46808 NUCLEAR-LEVEL DENSITIES FROM CROSS-SECTION FLUCTUATIONS. Gadioli, E.; Iori, I. (Univ., Milan. Istituto Nazionale di Fisica Nuclear, Milan). Nuovo Cim. (10), 51B: 100-13(Sept. 11, 1967).

The value of the level density $\rho(U,J)$ at ~7 MeV of excitation energy, for nuclei with $20 \lesssim A \lesssim 70$, obtained by analyzing slow-neutron resonances, is compared with the value at ~(15 to 20) MeV excitation energy, extracted from the coherence energies characterizing fluctuating excitation functions. The comparison seems to indicate that the Lang and Le Couteur level density formula gives a correct estimate of the energy dependence of the level density $\rho(U,J)$ with the following choice of the parameters: $R = 1.5A^{\frac{1}{3}}$ fm, $\mathcal{I} = 0.7\mathcal{I}_{rig}$, $a = (0.127A)$ $(MeV)^{-1}$, and if the quantity $\Delta U = (70/A)$ MeV is added to the effective excitation energy, evaluated by subtracting the pairing energy from the usual excitation energy. The method followed in the analysis and the results obtained are discussed. (auth)

46809 SEMIDIRECT ISOSPIN MIXING IN DEUTERON-INDUCED REACTIONS. Noble, J. V. (Univ. of Pennsylvania, Philadelphia). Phys. Rev., 162: 934-44(Oct. 20, 1967).

A new mechanism which leads to substantial violation of isotopic invariance in "direct" processes involving deuterons is suggested. The T-forbidden (d,α) cross section resulting from this mechanism is nearly comparable in magnitude with that from the formation of isotopically impure compound intermediate states. This new mechanism involves transitions from the S = 1 state of the deuteron to the S = 0, T = 1 "state." These transitions occur because the nucleon-target interaction contains a spin-orbit part; however, the Coulomb distortion of the proton wave function in the intermediate states causes an asymmetry in the spin-orbit potentials seen by the neutron and proton. Thus the spin of one nucleon is flipped more often than that of the other. Because the electromagnetic interaction merely provides the asymmetry factor (which is due to the long-range nature of the Coulomb potential), while it is the nuclear forces which actually flip the spins, this source of T = 1 admixture is far more important than two other "direct" mechanisms which have been suggested, namely, Coulomb polarization of the deuteron internal wave function, or preliminary (allowed) deuteron pickup leading to a T = 0 state of the residual nucleus, followed by Coulomb excitation to a T = 1 final state. Estimates of the forbidden reaction cross sections resulting from either the preferential spin-flip or the Coulomb-excitation mechanism are presented, and an experimental test of the new hypothesis is proposed. Finally, it is concluded from this investigation that the preferential spin-flip mechanism can explain the recent observations of Meyer-Schützmeister et al., both qualitatively and quantitatively. (auth)

46810 ANALYSIS OF RECOIL ANGULAR AND RANGE DISTRIBUTIONS FROM COMPOUND-NUCLEUS REACTIONS. Ewart, Alan; Kaplan, Morton (Yale Univ., New Haven). Contract AT(30-1)-3219. Phys. Rev., 162: 944-51(Oct. 20, 1967). (YALE-3219-16).

A method is presented for calculating the observable kinematic properties of nuclei recoiling from compound-nucleus reactions. The computations are performed by specifying center-of-mass distribution functions in angle and speed which arise from the emission of particles, and carrying out the appropriate integrations over laboratory speeds and angles. The calculated angular distributions, range distributions, and range distributions with angular restrictions (collimated ranges) are directly comparable to the corresponding properties measured in recoil experiments. Results are given for a number of compound-nucleus reactions induced by heavy ions and α particles, where sufficiently detailed experimental data are available for comparison. Very good agreement was obtained by assuming isotropic particle emission in the center-of-mass system and using a Maxwellian distribution of recoil speeds. The single parameter in the Maxwellian function was fixed by relating it to the mean-square velocity of the recoiling nuclei, the latter being determined from experimental angular distribution data by means of a previous analysis. The effects of different forms of the center-of-mass angular and velocity distributions on the calculated angular and range distributions are discussed. It is concluded that, in all the cases investigated, the recoil angular distributions are essentially isotropic in the center-of-mass system, with no more than a small anisotropy being allowed by the experimental data. Furthermore, velocity distributions which differ greatly from the Maxwellian form are not consistent with the observations. The laboratory velocity spectrum of recoils emitted within a small angular interval about 0° was calculated for a specific reaction and was found to resemble rather closely a recent experimental measurement of this distribution. (auth)

46811 NUMBER-CONSERVING TREATMENT OF PAIRING CORRELATIONS IN EVEN–EVEN NUCLEI. Covello, A. (Rutgers, The State Univ., New Brunswick, N. J.); Salusti, E. Phys. Rev., 162: 859-65(Oct. 20, 1967).

A simple method is proposed for treating pairing correlations in even-even nuclei without violating the particle-number conservation. A dispersion formula is derived which makes it possible to calculate the eigenenergies for a system with A particles, once the occupation numbers for the (A – 2)-particle system are known. This formula is used to calculate the ground-state energies for the even Ni isotopes; the results turn out to be much better than those obtained by the standard BCS method. The ground-state wave function is discussed and compared with the A-particle component of the BCS wave function. The possibility of treating neutron-proton correlations by the same method is also considered, and the general formulation is given for the case of a charge-independent pairing interaction between particles in nondegenerate orbitals. The degenerate model is studied in detail, and the approximate ground-state energy is compared with the exact one. The results obtained suggest that the present method may be usefully applied in the general case of nondegenerate levels. (auth)

46812 SCHEMATIC INTERACTIONS FOR NUCLEAR RANDOM-PHASE-APPROXIMATION CALCULATIONS. Rowe, D. J. (Univ. of Rochester, N. Y.). Phys. Rev., 162: 866-71(Oct. 20, 1967).

It is customarily believed that schematic interactions are useful for preliminary tests of nuclear models, but are otherwise too unrealistic to be of much value. In this paper, an attempt is made to point out that schematic interactions have a much firmer basis than was supposed, and can therefore be used with more understanding for some of the complex problems, that without simplification are essentially unassailable. An exact criterion is established for the validity of a schematic interaction on the basis of which a new schematic interaction is proposed. This interaction is compared with the surface delta interaction and the $P^{(2)}$ force. On the basis of our criterion, the radial form of the interaction is compared with that suggested for specific excited states, by random-phase-approximation calculations with more general forces. The agreement is favorable. (auth)

46813 THEORY OF ANGULAR CORRELATIONS FOR TWO NUCLEONS EMITTED IN THE NUCLEAR ABSORPTION OF SLOW PIONS. Koltun, Daniel S. (Univ. of Rochester, N. Y.). Contract AT(30-1)-875. Phys. Rev., 162: 963-70(Oct. 20, 1967). (UR-875-193).

A theory is developed for the angular correlation for two fast nucleons emitted when a nucleus absorbs a slow pion, based on the assumption that the reaction is direct. It is shown that for a quite general class of models for the two-nucleon absorption mechanism, there are selection rules which relate the final angular momenta of the two nucleons to the angular momenta carried initially by the two nucleons in the target nucleus. The selection rules involve the relative and center-of-mass motions, separately, of the nucleon pair. The angular correlation of interest is therefore defined with respect to the angle between the relative and cms momenta of the emitted nucleons. The selection rules provide a direct connection between the observed angular correlation and the two-nucleon angular momentum structure of the target nucleus. Some examples are given for the application of this theory to the study of nuclear structure. (auth)

46814 SECOND-ORDER CONTRIBUTION TO THE BINDING ENERGY OF CLOSED-SHELL NUCLEI WITH THE TABAKIN POTENTIAL. Kerman, A. K.; Pal, M. K. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Phys. Rev., 162: 970-5(Oct. 20, 1967). (MIT-2098-335).

Hartree-Fock calculations were performed previously on the binding energy of closed-shell nuclei using Tabakin's separable nonlocal two-nucleon potential. An evaluation of the second-order correction to the binding energy of ^{16}O and ^{40}Ca are reported. Including the second-order terms, binding energies of 6.7 and 10.9 MeV, respectively, are obtained for these two nuclei. (auth)

46815 SECONDARY PARTICLE SPECTRA FROM THE INTERACTION OF 30- TO 340-MeV PROTONS ON COMPLEX NUCLEI: EXPERIMENTAL DATA AND COMPARISON WITH THEORY. Bertini, Hugo W. (Oak Ridge National Lab., Tenn.).

Contract W-7405-eng-26. Phys. Rev., 162: 976-82(Oct. 20, 1967). (ORNL-P-2894).

A few serious discrepancies or anomalies exist in the measured neutron and proton spectra from the interaction of protons with nuclei in the 100-MeV energy region. These are the existence of a pronounced quasi-elastic neutron peak at small forward angles for 140-MeV incident protons and the unexplained absence of such a peak for 100-MeV protons; a target-mass dependence of the measured neutron spectra at small angles from 160-MeV protons that is inconsistent with the 140-MeV data; and an inconsistency in the shapes of some of the measured secondary-proton spectra. These discrepancies are illustrated, and comparisons with the theoretical predictions of an intranuclear-cascade calculation are made. However, the existence of the experimental discrepancies makes it difficult to evaluate the validity of any theoretical model which is used in the prediction of these data; therefore, additional experiments are needed. (auth)

46816 COLLECTIVE CORRELATIONS IN SPHERICAL NUCLEI AND THE STRUCTURE OF GIANT RESONANCES. Drechsel, Dieter (National Bureau of Standards, Washington, D. C.); Seaborn, J. B.; Greiner, Walter. Phys. Rev., 162: 983-91(Oct. 20, 1967).

The theory of collective correlations in nuclei is formulated for giant resonances interacting with surface vibrations. The giant dipole states are treated in the particle-hole framework, while the surface vibrations are described by the collective model. Consequently, this treatment of nuclear structure goes beyond both the common particle-hole model (including its various improvements which take ground-state correlations into account) and the pure collective model. The interaction between giant resonances and surface degrees of freedom as known from the dynamic collective theory is formulated in the particle-hole language. Therefore, the theory contains the particle-hole structures and the most important "collective intermediate" structures of giant resonances. Detailed calculations are performed for ^{12}C, ^{28}Si, and ^{60}Ni. A good detailed agreement between theory and experiment is obtained for all these nuclei, although only ^{60}Ni is in the region where one would expect the theory to work well ($50 < A < 110$). (auth)

46817 ANGULAR DISTRIBUTION OF GAMMA RAYS FROM HIGH-SPIN STATES IN DEFORMED ODD-A NUCLEI. Sperber, Daniel (Rensselaer Polytechnic Inst., Troy, N. Y.). Phys. Rev., 162: 1022-6(Oct. 20, 1967).

The angular distribution of γ rays emitted by deformed odd-A nuclei with high spin was calculated. The results are applicable to emission from states populated during heavy-ion bombardment. The effect of polarization of the spin of the compound nucleus in a plane perpendicular to the heavy-ion beam is considered. Contributions from pure E2 and M1 radiations, as well as from interference between these two radiations, are included. It is shown how experimentally measured angular distributions can be used as a tool for determining both the magnitude and the relative phase of the amplitude of E2 and M1 transitions. (auth)

46818 COUPLED PARTIAL DIFFERENTIAL EQUATIONS FOR TRINUCLEON RADIAL WAVE FUNCTIONS. Bolsterli, M. (Los Alamos Scientific Lab., N. Mex. Univ. of Minnesota, Minneapolis). Contract W-7405-eng-36. Phys. Rev., 162: 1008-21(Oct. 20, 1967). (LA-DC-8885; COO-1371-1).

The differential equations for the triton are derived by procedures that can be used also for other values of TJπ. (auth)

46819 UNITARY MODIFICATIONS OF THE IMPULSE APPROXIMATION. Sloan, Ian H. (Univ. of New South Wales, Kensington). Phys. Rev., 162: 855-8(Oct. 20, 1967).

Unitary modifications of the impulse approximation, proposed by Rosenberg and Queen, are investigated; and the connection between them is established. It is shown that Queen's approximation does not in fact ensure elastic unitarity, and that if Queen's approximation is modified so as to retain the unitarity constraint, then Rosenberg's approximation is obtained. In preliminary elastic-scattering calculations on a soluble three-body model, it is found that unitarity is violated strongly by the impulse approximation, and to a smaller extent by Queen's approximation. Both of the unitary modifications substantially reduce the impulse-approximation differential cross sections and yield improved results in the forward hemisphere. (auth)

46820 UPPER BOUNDS FOR ERRORS OF EXPECTATIONS IN THE FEW-BODY PROBLEM. Aranoff, Sanford (Rutgers Univ., Newark, N. J.); Percus, Jerome K. Contract AT(30-1)-1480. Phys. Rev., 162: 878-83(Oct. 20, 1967).

Exact upper bounds are established for the errors associated with approximate computations of total, kinetic, and potential energies of a few-body system. As a consequence, error bounds are also established for arbitrary coordinate functions. Reduction methods are developed to treat expectations of coordinate functions which are divergent at some spatial point, e.g., the delta function or the inverse square, or at infinity, e.g., the mean-square radius. Positronium is used as a test case to study the relative accuracy of the estimates. (auth)

46821 QUANTUM MECHANICAL EFFECTS IN MULTIPLE COULOMB EXCITATION. Smilansky, U. (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Lett., 25B: 385-7(Oct. 2, 1967).

The quantum-mechanical effects in multiple Coulomb excitation and their effects in quadrupole moment measurements are investigated analytically (for a simple one dimensional case) and numerically. It is found that their effect might be sometimes quite important although for the experimental conditions of the recent quadrupole moment measurements they are of the order of a few percent. (auth)

46822 ANHARMONIC EFFECTS IN EVEN–EVEN DEFORMED NUCLEI. Jolos, R. V.; Solov'ev, V. G.; Zheleznova, K. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Lett., 25B: 393-5(Oct. 2, 1967).

The admixture of the two-phonon states to the lowest one-phonon states in even-even deformed nuclei removed from the transition regions is considered. It is shown that this admixture is small. It means that the anharmonic effects are not important in even-even deformed nuclei. (auth)

46823 AN ANALOG OF THE JOSEPHSON EFFECT IN NUCLEAR TRANSFORMATIONS. Gol'danskii, V. I.; Larkin, A. I. (Inst. of Chemical Physics, Moscow). Zh. Eksp. Teor. Fiz., 53: 1032-7(Sept. 1967). (In Russian).

Various processes of tunneling of nucleons through the potential barrier dividing interacting nuclei at the smallest possible classical distance are observed in nuclei bombarded by heavy ions. It is shown that nucleon pairing may result in a significant increase of the cross section for transmission of neutron or proton pairs, a phenomenon which in some respects is similar to the Josephson effect in superconductors. The probability for excitation of various levels in single-nucleon exchange is found by taking into account pairing. Previously such a probability was calculated by Breit and Ebel without taking into account the correction mentioned. The probability for two-nucleon exchange is determined. An expression for two-proton radioactivity is derived by taking into account any number of arbitrary levels which in the limiting case of a single S level goes over to the Galitsky–Cheltsov formula. (auth)

46824 NUCLEAR REACTION Q-VALUES. Maples, Creve; Goth, George W.; Cerny, Joseph (Univ. of California, Berkeley). Nucl. Data, Sect. A, 2: 429-612(Dec. 1966).

Tables of Q-values for nuclear reactions were calculated from currently available mass data. The calculations were performed for reactions on targets including all the stable or naturally occurring radioisotopes with $Z = 2$ to 92 and long-lived isotopes of $Z \leq 20$. (auth)

46825 HIGH-ENERGY NUCLEAR STRUCTURE PHYSICS AND A MYSTERY. Wilkinson, Denys H. Comments Nucl. Particle Phys., 1: 169-73(Sept.-Oct. 1967).

A brief review of techniques for studying nuclear structure is presented with emphasis on the advantages of using pion-induced reactions. It is noted that the experimentally obtained value for the ratio of the cross sections for the production of ^{11}C by meson (π^-) and (meson$^+$) reactions on ^{12}C is only about 33% of the value that is expected on the basis of a simple knockout mechanism. Similar results are noted to hold for meson (π^+) reactions on ^{16}O with the production of ^{15}O. The interpretation of the discrepancy is briefly discussed. (D.C.W.)

46826 RELATION BETWEEN THE REAL PARTS OF THE NUCLEON AND DEUTERON OPTICAL POTENTIALS. El-Nadi, M.; Zohni, O. (Cairo Univ.). Z. Phys., 206: 18-28(1967).

The relation between the parameters of the optical potential of the deuteron and those of its constituent nucleons is investigated. An analytical expression for the real depth of the deuteron potential is derived, where it is represented as the sum of the proton and neutron real potentials minus a correction factor. Optical-model analysis is carried out for deuteron and proton elastic scatterings in order to test the derived relation. (auth)

46827 THE WOODS–SAXON WAVE FUNCTIONS AND THE BETA TRANSITIONS OF DEFORMED NUCLEI. Bogdan, D. (International Atomic Energy Agency, Trieste, Italy). Z. Phys., 206: 49-65(1967).

The general expressions for the beta transition matrix elements

were obtained using the Woods-Saxon wave functions for deformed nuclei proposed by Faessler and Sheline. As an application the matrix elements for the $1^-(\beta^-)0^+$ and $1^-(\beta^-)2^+$ transitions of the ^{170}Tm nucleus were calculated. The results indicate significant differences between the Nilsson and Woods-Saxon values of the nuclear parameters. Assuming a reasonable K = 0 mixture in the ground state of the ^{170}Tm nucleus and a value near the Ahrens-Feenberg estimate for the $\int \alpha / \int$ ir ratio, it is possible to obtain an important improvement of the theoretical values of the relevant observables and especially of the ft values. (auth)

46828 SIZE AND FORM OF THE NUCLEUS. Bromley, D. A.; Weneser, J. Comments Nucl. Particle Phys., 1: 174-9 (Sept.-Oct. 1967).

Some relatively new techniques for measuring the size or form of the nuclear charge distribution are briefly discussed, including electron-beam scattering, x-ray spectra of μ^--mesic atoms, and Coulomb energy differences between analog states. Some experimental results on Ca isotopes are discussed, together with the shell-model interpretation. The determination of neutron radii from Coulomb energy differences is also briefly considered. (D.C.W.)

46829 THEORY OF HINDERED GAMOW-TELLER MATRIX ELEMENTS. Fujita, Jun-ichi; Futami, Yasuhiko; Ikeda, Kiyomi (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 38: 107-43(July 1967).

The commutator method which was previously proposed for the purpose of calculating hindered matrix elements is applied to the Gamow-Teller beta matrix elements of heavier nuclei. It is shown that a number of empirical ft-values of the unfavored transitions can be well reproduced in terms of the conventional pairing model without invoking the phenomenological effective coupling constant. It is also shown that the l-forbidden transitions can be treated on the same footing as the unfavored ones. In such a treatment tensor forces play an important role. General forms of the effective single-body transition operators are derived on the basis of the commutator method, and qualitative discussions are given. (auth)

46830 NUCLEAR FORCE AND NUCLEAR MATTER. II. Takada, Kenjiro; Takagi, Shuji; Watari, Wataro (Osaka City Univ.). Progr. Theor. Phys. (Kyoto), 38: 144-52(July 1967).

The saturation curves of nuclear matter are calculated by using the reference spectrum method for the one-boson-exchange potentials with various hard core radii. The hard core radius is varied continuously down to zero without changing the two-nucleon scattering phase shifts up to ~300 MeV. A Gaussian type soft core potential derived by Tamagaki is also used and the result is compared with that of Harada et al., who calculated with a rather exact method. It is found that from this comparison that the reference spectrum approximation is quite good if the reference spectrum parameters are carefully chosen. From the results obtained by using the one-boson-exchange potentials, it is shown that the soft core potential is more favorable for the binding energy of the nuclear matter than a potential with big hard core radius and that there is no essential difference between the soft core potential and the hard core one core radius of which is smaller than 0.2 fm. (auth)

46831 NUCLEAR SHELL MODEL STUDIES IN THE MASS REGION NEAR A = 88. Tarbutton, Robert Michael. Nashville, Vanderbilt Univ., 1967. 99p.

Thesis.

Hughes, Snow, and Pinkston have made least squares fits of the strength parameters of a T = 1 central-plus-tensor interaction for nuclei treated as two particles outside a closed shell. They found a potential which fits well both ^{18}O and ^{210}Po and which has some of the properties of the free two-nucleon potential; however, their treatment of ^{86}Sr and ^{90}Zr using a ^{88}Sr core gave a rather poor fit and an interaction which is rather unrealistic. Assuming that ^{88}Sr is not a good core, several nuclei were treated as consisting of a core of 50 neutrons and 28 protons, with protons in the $1f_{\frac{7}{2}}$, $2p_{\frac{3}{2}}$, $2p_{\frac{1}{2}}$, and $1g_{\frac{9}{2}}$ shells interacting through the ^{18}O-^{210}Po potential. These calculations, including as many as four $g_{\frac{9}{2}}$ particles, were performed using a shell-model program written for the IBM-7090 computer. Starting with an estimate based on first-order perturbation theory, the single-particle energies were varied to give a good fit to the known energy levels of ^{87}Rb, ^{88}Sr, ^{89}Y, and ^{90}Zr. A few spectroscopic factors were also calculated which gave relatively poor agreement with experiment. (Disser. Abstr.)

46832 THREE-BODY INTERACTIONS IN NUCLEAR MATTER. Kirson, Michael Wolf. Ithaca, N. Y., Cornell Univ., 1966. 137p.

Thesis.

The contribution of three-body interactions to the binding energy per nucleon and the single-particle potential energy in nuclear matter is investigated by means of the Bethe-Faddeev equations. The momentum dependence of the integral operators in the equations is calculated and it is found that only a small range of momentum values is important. This allows a reduction of the equations to a much simpler form. Two approximate solutions to the equations are thus obtained, in terms of the solution of the two-body problem in nuclear matter. A detailed calculation of two-body wave functions is performed, using a pure Serber force standard hard core potential, and the results used to obtain the approximate three-body wavefunctions. These are then utilized in calculating the binding energy per nucleon due to three body interactions and in computing the spectrum of "particle" states. It is confirmed that the principal effect of the three-body interactions is to suppress the repulsion due to the hard core of the potential. The binding energy per nucleon from three-body interactions is only 13% of that from two-body interactions, which indicates that the binding energy expansion, rearranged as an expansion in the number of interacting nucleons (which corresponds closely to an expansion in the density of the system), converges rapidly. The particle spectrum obtained is very attractive, and even becomes lower than the hole spectrum near the Fermi surface. It is suggested that this might be avoided by treating the long- and short-range parts of the potential differently in defining the particle spectrum. (Disser. Abstr.)

46833 SPIN-DEPENDENT EFFECTS ON THE DIFFERENTIAL CROSS SECTION AND POLARIZATION FOR THE (α,N) REACTION. Kelley, Timothy G. Seattle, Univ. of Washington, 1966. 158p.

A study is made of the effects of spin-dependent forces on direct reaction cross sections and polarizations, with special emphasis placed on the (α, nucleon) reaction. This reaction is particularly suited to this study because only the outgoing particles can suffer spin-dependent interactions. The investigation is carried out in a DWBA framework and is specifically concerned with the dependences of the cross section and polarization on the spin-orbit potential for the outgoing nucleons, the spin dependence and structure of the interaction causing the reaction, and the orbital-spin angular momentum coupling of the captured particles (J-dependences). Very general relations are derived which connect the first-order corrections to measurable quantities that correspond to a set of related nuclear transitions (all J for a given L in stripping processes, for example) due to spin-dependent distortions. These apply to a wide range of direct reactions, including those having particles with non-zero spin in both channels, and permit the experimental isolation of the effects of spin-dependent distortions o of a given rank. Substantial J-dependences in the computed (α,N) cross sections are found even at forward scattering angles, and arguments are presented that support the spectroscopic reliability of these results, utilizing a modified diffraction model. The diffraction model is used also to provide considerable understanding of several angular momentum-dependent features of the computed polarizations. It is found that structure in the interaction leads to sizable effects in the polarization, for the knockout mode, and one of these effects appears to offer a means by which to experimentally discriminate between this and the stripping mechanism for the (α,N) reaction. Several predictions suggesting experimentation are made. (Disser. Abstr.)

46834 APPLICATION OF MULTIPARTICLE COLLISION THEORY TO THE STUDY OF DIRECT NUCLEAR REACTIONS. Noble, Julian Victor. Princeton, N. J., Princeton Univ., 1966. 114p.

Thesis.

The solution of problems in nuclear physics from the viewpoint of multi-particle collision theory is examined. Non-relativistic collision theory is briefly reviewed with particular emphasis given to recent developments in multi-particle potential scattering theory. A new set of linear integral equations describing deuteron scattering is derived using methods similar to those of Faddeev, et al. These equations (of Fredholm type) are contrasted with the usual distorted wave Born approximation treatment of deuteron reactions. Various simplified versions of these equations are described. The numerical solution of a simple test case is discussed. New results contained are: an existence proof of spurious homogeneous solutions of Weinberg's three-body equations (in a special case); a new set of three-particle scattering equations particularly suited to deuteron collisions; and a new method of proof for the existence of the analytic continuations of three-particle amplitudes (defined for complex energy) to real, positive energies. (Disser. Abstr.)

46835 VARIATIONAL EQUATIONS IN INELASTIC SCATTERING. Macek, Joseph Henry. Troy, N. Y., Rensselaer Polytechnic Inst., 1964. 78p.

Thesis.

Equations are given relating the variation of the scattering amplitudes and the S and K matrix elements to variations of the energy ergy and the potentials in inelastic scattering. These are applied to the problem of proving rigorous lower bounds to the scattering phase shifts and the K matrix elements. (Disser. Abstr.)

46836 THEORY OF FINITE FERMI SYSTEMS AND APPLICATIONS TO ATOMIC NUCLEI. Migdal, A. B. Interscience Monographs and Texts in Physics and Astronomy. Volume XIX. New York, John Wiley and Sons, Inc., 1967. 326p. $17.50.

Translated from the Original Manuscript by S. Chomet.

An introduction is given to the physical properties of Fermi ıystems, followed by application of Green's functions to Fermi systems, external field effects, and applications to nuclear physics. (S.F.L.)

REACTOR TECHNOLOGY

Central Power Reactors

Refer also to abstracts 45190, 45191, 45198, 45199, 45220, 45297, 45873, 45878, 45974, 45977, 45987, 45988, 45994, 46029, 47050, and 45286.

46837 (ANL-7325, pp 136-78) REACTOR SAFETY. Baker, L. Jr.; Tevebaugh, A. D.; Bingle, J. D. (Argonne National Lab., Ill.).

Developments are reported for studies on: isothermal stainless steel-steam reaction; isothermal Ni-steam reaction; reaction of flowing steam with Zircaloy-2-clad, UO_2-core simulated fuel elements; calculation of the extent of metal-water reaction and core heating during a loss-of-coolant accident; loss-of-coolant simulation experiments in TREAT on Zircaloy-2-clad UO_2-core fuel clusters; photographic studies of metal-clad, UO_2-core fuel rods in TREAT; measurement of heat flux from a heated metal sphere moving through liquid sodium and water; TREAT studies of fuel meltdown in sodium; high temperature thermal properties of UO_2; fuel migration; and Na-air reactions. (P.C.H.)

46838 (BMI-1814) INVESTIGATION OF TECHNIQUES FOR SAMPLING AND ANALYSIS OF IODINE UNDER SIMULATED REACTOR ACCIDENT CONDITIONS. Howes, James E. Jr.; Ritzman, Robert L.; Morrison, David L.; Townley, Charles W. (Battelle Memorial Inst., Columbus, Ohio). Sept. 27, 1967. Contract W-7405-eng-92. 20p. Dep. CFSTI.

For Battelle-Northwest, Richland, Wash., Pacific Northwest Lab.

Glass beads, silicone-coated glass beads, and K_2CO_3 were evaluated and found to be unsatisfactory as potential materials for distinguishing between various forms of iodine. While anion exchange resins quantitatively retained both I_2 and HI, a cation exchange resin retained HI nearly quantitatively, yet retained only about 3 percent of I_2 in moist air at 80°C. Charcoal-impregnated paper, Solvinert filters, glass fiber filters, and Millipore Mitex filters were evaluated for trapping particulate iodine compounds. The glass fiber filter normally used in Maypacks retained from 33 to 100 percent of the I_2 and HI under moist air and steam-air conditions and at low iodine concentrations. At higher concentrations, the retention of I_2 under both conditions dropped to about 1 to 4 percent. Millipore Mitex filters showed the lowest retention, with only HI in moist air at room temperature retained in significant quantity. An ion exchange sampler was evaluated along with a CSE Maypack using high-humidity air at 90°C and a flow rate of 3000 cm^3 per min. He 10 v/o H_2 was used in place of air in the HI experiments. Under the conditions of higher flow rate and lower iodine species concentration, the cation exchange resin bed retained a relatively high percentage of I_2 and only 74 percent HI. During the course of the program CSE Maypacks were evaluated under various atmospheric conditions such as steam-air, moist air, He-H_2, and steam-H_2. (auth)

46839 (COO-651-51) ELK RIVER REACTOR FIFTY-NINTH MONTHLY OPERATING REPORT. (Rural Cooperative Power Association, Elk River, Minn.). Sept. 1967. 19p. Dep. CFSTI.

The reactor operated for the entire month of September with total electrical production at 13,580,000 kwh. The reactor operated at 79.2% of rated thermal capacity, and electrical production was 85.7% of rated capacity. Major activities in the nuclear plant included: routine maintenance and testing; painting reactor equipment and floors; revising operating manual; inspection of unirradiated fuel elements; design and review of an alternate system for primary water make up; decay heat pump piping revisions; and technical specifications tests. At the end of September, total Cycle 3 production was 4590.9 MWd, which is approximately 27% of the expected entire Cycle 3 production. (auth)

46840 (COO-652-43) MONTHLY OPERATING REPORT NO. 53. (Piqua Nuclear Power Facility, Ohio). Sept. 1967. 17p. Dep. CFSTI.

Operation and maintenance report for September, 1967 of the Piqua Nuclear Power Facility includes: reactor operation; organic systems; control and safety systems; auxiliary systems; fuel status; administration; process engineering; and health and safety. (D.C.C.)

46841 (EUR-3478i) RISULTATI DELLO STUDIO RELATIVO ALLE PROSPETTIVE DI UTILIZZAZIONE DEL PLUTONIO NEI REATTORI AD ACQUA DELL'ENEL. (Results of the Enquiry into the Prospects for the Use of Plutonium in ENEL Water Reactors). Ariemma, A.; Belelli, U.; Lesnoni, G.; Rosa, I.; Sani, L.; Zaffiro, B. (Ente Nazionale per l'energia Elettrica, Rome (Italy)). 1967. 234p. (In Italian). Dep.

ENEL has begun a programme on the prospects of using Pu in thermal reactors; it will be based on experimental studies in one of their own water reactors, namely, either the Garigliano 160 MWe BWR reactor or the 300 MWe Trino Vercellese PWR reactor. The results of the physical, economic and safety studies made in order to act as a guide for the ENEL in choosing the reactor on which to concentrate subsequent studies and perform tests are presented with a view to the use of Pu in regular reloads after 1971-1972. (auth)

46842 (EURAEC-1834) STABILITY EXPERIMENTS FOR BOILING WATER REACTORS. Quarterly Report No. 9, January 1-March 31, 1967. (Allgemeine Elektricitaets-Gesellschaft, Frankfurt am Main (West Germany). Kernenergieanlagen). Contract 085-66-1TEED. 42p. (EUR-3357). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

Initial measurements were made on the four-rod cluster geometry: stationary density measurements and pressure drop measurements at various heights and with various water inlet velocities as well as 5 "heat transferred per surface unit-local steam bubble fraction" frequency characteristic measurement series. These measurement series were selected to allow a direct correlation with the frequency characteristics obtained for the cylindrical geometry. The evaluation of these measurements is proceeding. To ensure proper identification of "heating tube-coolant" heat transfer, measurements were made on the heat transfer tubes in order to identify the heat-transfer coefficients of the material of which they are made. A method for deriving characteristic dynamic constants for the boiling zone from correlations revealed by stationary measurements is developed. The comparison between theory and experiment, using the AMOK-L computer program for the cylinder frequency characteristic measurements, was virtually completed. (auth)

46843 (EURAEC-1884) USE OF PLUTONIUM AS A FUEL IN NUCLEAR REACTORS. Annual Report, January 1-December 31, 1965. Special Report No. 6. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium)). Dec. 1966. Contract 001-64-1TRUB. 71p. (EUR-3380). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

The preparation of vibrating mixed UO_2-PuO_2 powders is described. The fabrication of Pu rods and their irradiation in the Br-3/PWR reactor is discussed. A fuel assembly of the Br-3/Vulcain type, comprising 18 rods with 6% enrichment and 1 rod 5% enriched with fissile $^{239}Pu + {}^{241}Pu$, was selected for assessment of Pu behavior in reactors. The study of the thermal behavior of UO_2-PuO_2 fuels in the BR-2 is described. Methods of determining the burnup ratio of fuels are examined. Dissolution and purification processes for plutonium are presented. (D.C.C.)

46844 (EURAEC-1898) STUDIES ON CYCLONES FOR STEAM SEPARATION IN BOILING-WATER REACTORS. Annual Report, 1966. Special Report No. 1. Vollradt, Faerber (comp.) (Allgemeine Elektricitaets-Gesellschaft, Frankfurt am Main (West Germany). Kernenergieanlagen). Contract 083-66-1TEED. 106p. (EUR-3390). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

For technical reasons relating to the reactor the coolant in boiling-water reactors must be as free of bubbles as possible when it flows back into the downcomer space. A steam quality of $x \leq 0.2\%$ is usually admitted. In reactors of over 60 MWe the natural effect of gravity is no longer sufficient for steam separation purposes and centrifugal separators have to be fitted if the separation process is to take place inside the pressure vessel. For the Lingen nuclear power plant, AEG developed special gravity-type cyclones which are mounted in the downcomer space and are hoped to be an improvement on other forced-separation systems from the operational and economic angle. This 160 MWe reactor, in which the circulation is regulated down to 25% partial load, is fitted with 88 cyclones with an inner diameter of 170 mm and a length of about 3.4 m, into which the coolant flows tangentially. These give an additional pressure drop of 0.42 atm at the circulating pumps. The extent to which the results of air/water tests can be transferred to reactor conditions are determined. Comparison of the data obtained with air/water and steam/water experiments show that the majority of preliminary tests can be performed with the less complicated air/water mixtures. The

cyclone used as a separator in the Lingen plant has not yet been optimized as regards the pressure drop and the capacity. It is therefore possible to increase its specific capacity by optimizing the cyclone dimensions. In addition, it is necessary to lower the specific capacity of the individual cyclone by using as many cyclones as possible in the given downcomer. For this reason the tangential inflow of the cyclones was changed into axial ingress from above, so that the inlet chambers are no longer required. Appropriate air/water tests show that the functioning of the individual cyclones is not adversely affected by this, but experiments with two cyclones of this type switched in parallel show that the mixture distribution to cyclones which are mounted at various distances from the reactor core is still unsatisfactory. (auth)

46845 (EURAEC-1910) RESEARCH PROGRAM FOR THE GARIGLIANO NUCLEAR POWER STATION. Quarterly Report No. 13. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). July 1, 1967. Contract 101-63-11-RD-I. 18p. (EUR-3395). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

Off-line use of the computer for the Garigliano Power Reactor is discussed. Radiation effects on resistance and insulation materials for containment vessel penetrations cable connectors are tabulated. Results of a computer simulation of increased station output are detailed. An analysis of the data from previous stability tests is reported. (M.L.S.)

46846 (EURFNR-311) THE FUEL CYCLE INDUSTRY IN AN EXPANDING NUCLEAR ECONOMY. Gupta, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Feb. 1967. 27p. (KFK-565). Dep.

Includes The Closed Fuel Cycle (An Introduction), by W. Haefele.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

The role of the nuclear fuel cycle in an expanding nuclear industry is discussed. A method for calculating fuel cycle capacities is presented. The economics are related to fuel cycle capacities and fabrication and reprocessing requirements. Considerations of supply and demand for uranium are discussed. 22 references. (M.L.S.)

46847 (EURFNR-367) SOME CONSIDERATIONS ON GAS COOLING FOR FAST BREEDERS. Dalle Donne, M.; Eisemann, E.; Wirtz, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). May 1967. 15p. (KFK-595). Dep. CFSTI.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

The use of He and CO_2 as coolants for fast breeder reactors is examined from the standpoint of recent technical improvements in components and materials necessary for the development of such reactors. The development of prestressed concrete pressure vessels, the use of roughened fuel element surfaces, the development of V-alloys with good high temperature properties for fuel cladding, and improvements in gas turbines are briefly discussed, and the technical factors involved in the choice of He or CO_2 as coolant are examined. (H.D.R.)

46848 (EURFNR-368) SAFETY FEATURES OF A 300 MWe SODIUM COOLED FAST BREEDER REACTOR (Na2). Schiechtendahl, E. G.; Cramer, M.; Gast, K.; Heusener, G.; Merk, W.; Schikarski, W.; Schoenfeld, E.; Smidt, D. (Kernforschungszentrum, Karlsruhe (West Germany)). June 1967. 29p. (KFK-611). Dep. CFSTI.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

The conceptual design of the 300 MWe Na cooled fast breeder reactor Na-2 is described. Emphasis is laid upon the safety related design aspects. The results of the analysis of typical reactivity insertions and coolant system failures are given. The potential consequences of severe nuclear accidents are analyzed and the containment capability of the design chosen is demonstrated. (auth)

46849 (GA-8069) NEFIRS: A COMPUTER PROGRAM FOR EXPLORATORY STUDIES OF NEUTRON FLUX DISTRIBUTIONS IN REACTOR SHIELDS. Goetzmann, C. A. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Aug. 18, 1967. Contract AT(04-3)-167. 70p. Dep. CFSTI.

NEFIRS (neutron fluxes in reactor shields) is a one-dimensional computer program based upon the principles that the neutron population of a region outside a reactor core is determined by the high-energy fission neutrons escaping from the core. The code, written in FORTRAN IV, consists of five basic sections of a main program. These sections are: (1) a routine to determine the spatial variation of the uncollided flux in the shield resulting from fission sources within the core, (2) a routine that computes from a library of basic data the neutronic constants necessary for an eight-group diffusion calculation through the various layers of structural or shielding materials surrounding the core, (3) a routine to solve the one-dimensional diffusion equation for a multilayer shield arrangement in one of the three standard geometries, (4) a library containing the basic data for up to twenty shield materials, and (5) a routine to evaluate the second-order exponential integral used in the analytic evaluation of the spatial distribution of the uncollided flux. (auth)

46850 (GA-8169) COMPARATIVE REVIEW OF TWO-DIMENSIONAL KINETICS METHODS. Hansen, K. F. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Aug. 18, 1967. Contract AT(04-3)-167. 46p. Dep. CFSTI.

Certain methods of solution for two-dimensional, multigroup, reactor kinetics problems are reviewed. Based upon the analysis of computing requirements, and the properties of the existing UNIVAC-1108 computer equipment at General Atomic, certain recommendations are made with respect to what methods should be pursued to develop a production code. Some suggestions are also made regarding areas of further methods development. The methods which are reviewed include the following: Explicit Integration, WIGL2 Method, GAKIN Method, ADI Methods, VARIQUIR Method, and GRCORK Method. The results of the study indicate that a practical 2-D kinetics code for the existing UNIVAC-1108 is possible. The most favorable method of solution is probably the ADI with the GRCORK and GAKIN approaches less attractive, but still potentially useful. (auth)

46851 (GAMD-7545) WIGL2 MODIFIED FOR USE ON THE UNIVAC 1108. A SUPPLEMENT TO THE WESTINGHOUSE REPORT NUMBER WAPD-TM-532. Johnson, Stephen (General Dynamics Corp., San Diego, Calif. General Atomic Div.). June 5, 1967. Contract AT(04-3)-167. 107p. Dep. CFSTI.

A one-dimensional, two-group, space-time dependent diffusion theory code utilizing either zero, one, or six delayed neutron groups is presented. The program, WIGL-2, will treat slab, cylindrical, and spherical geometries and includes non-boiling heat transfer. Feedback due to xenon buildup, temperature changes, and control rod motion can be calculated; transients may be effected by variations in inlet coolant temperature, coolant flow rate, or rod positions. Input specifications are detailed. Limits on variable data storage is discussed. (M.L.S.)

46852 (GAMD-7994) HTGR LONG-TERM SPENT FUEL STORAGE COSTS. Seden, W. H. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Sept. 1, 1967. Contract AT(04-3)-167. 27p. Dep. CFSTI.

Economics of on-site storage for both canned and uncanned spent hexagonal block fuel elements containing loose, unbonded pyrolytic-carbon-coated fuel particles is discussed. Cost estimates include capital, manpower, utility, and maintenance materials. A design for a typical facility is given. Safety aspects are considered. (M.L.S.)

46853 (GEAP-4917) FISSION GAS ACTIVITY RELEASED FROM FAILED STAINLESS STEEL-CLAD FUEL RODS DURING OPERATION IN THE VBWR. Ogawa, S. Y.; Williamson, H. E. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Sept. 1965. Contract AT(04-3)-189. 58p. Dep. CFSTI.

The activity levels associated with the release of fission products from both purposely defected and service failures in Type-304 stainless steel or Zircaloy-2 clad UO_2 fuel rods during operation of the Vallecitos Boiling Water Reactor were analyzed in an attempt to find a correlation between the amount of activity released and the severity of the defect in individual fuel rods, and to ascertain a rate of deterioration. Specifically presented are the measured levels of activity released through holes drilled in the cladding and by service defects, the estimated activity release rates from service failures of different degrees of severities, and a deduced rate of increase in activity release apparently associated with rate of rod deterioration. (H.D.R.)

46854 (GEAP-5098) SODIUM-COOLED REACTORS FAST CERAMIC REACTOR DEVELOPMENT PROGRAM. Quarterly Report No. 17, November 1965–January 1966. Breizy, C. E. (comp.) (General Electric Co., San Jose, Calif. Advanced Products Operation). Feb. 1966. Contract AT(04-3)-189. 80p. Dep. CFSTI.

REACTOR FUEL ELEMENTS — radiation testing of fast ceramic; development of vented fast ceramic, specimen testing for; compatibility of sodium with unified-oxide, experiments on; transient testing in TREAT of preirradiated mixed-oxide; cladding for, neutron dose during TREAT transient studies to; performance evaluation of fast mixed-oxide; burnup analysis of irradiated; burnup analyses for fast flux irradiated; physi-

cal properties of fast oxide, metallographic determination of calculations; cladding-to-pellet tolerances for, effects of; cladding for fast ceramic, evaluation of
REACTORS, FAST — neutron kinetics calculations for ceramic, use of multigroup two-dimensional computer code for; transient calculational methods for, development of; power distribution in ceramic determination of; temperature distribution in ceramic, determination of; cores for ceramic, temperature distribution for
STAINLESS STEEL — tensile properties of type 316-L; swaging of type 304, results of cold
FISSION PRODUCTS — release from fast mixed-oxide fuel elements during TREAT transient testing
PLUTONIUM — diffusion in irradiated fuels, determination of axial
SODIUM — compatibility, with mixed-oxide fuel, experiments on (M.L.S.)

46855 (JAERI–1135) WATER CHEMISTRY OF JPDR. Ishiwatari, Nasumi (Japan Atomic Energy Research Inst., Tokyo). Oct. 1966. 21p. Dep.

In order to perform more reliable measurements in the chemical aspect of the JPDR reactor, numerous data have been measured since the initial power-up test. The results of these measurements are summarized in this paper. From these results, the release rates of radioiodine and metals such as iron, copper and nickel were estimated and analysed, and the following are concluded: the reliability of the results of the initial power-up test and the excellence of the chemical aspect of this reactor, including the suppression of the release of the radioiodine from the coolant system, the accumulation of corrosion products and the transfer and the deposition of the radioactive nuclides in the coolant system, have been confirmed through these measurements. The chemical aspects of the JPDR with those of other BWRs are also compared. (auth)

46856 (JUL–419-RG) BERECHNUNG VON STREUMATRIZEN FUER DIE MATERIALIEN DES MOSEL-REAKTORS. (Calculation of Scattering Matrices for the Materials of the MOSEL Reactor). Gerwin, H. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Oct. 1966. 120p. (In German). Dep.

For fast and epithermal reactors the accurate knowledge of scattering data is of great importance. Therefore new scattering data for the elements and isotopes used in the Mosel reactor were considered, and a computer program, for their evaluation and for the calculation of new scattering matrices, is described. In the program the mean flux in the individual groups can be chosen at random. The effects of the new scattering data and the different mean spectra on the criticality and on $\bar{\eta}$, the mean number of neutrons per absorption in ^{233}U was investigated in a hard and a soft Mosel arrangement. (tr-auth)

46857 (JUL–474-RG) DER KUGELHAUFENREAKTOR ALS THERMISCHER THORIUMBRUETER. I. GRAPHIT ALS MODERATOR. (The Pebble-Bed Reactor as a Thermal Thorium Breeder. I. Graphite as Moderator). Brandes, S. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Jan. 1967. 43p. (In German). Dep.

The breeding properties of a graphite-moderated high temperature reactor of the pebble bed type was investigated for a $^{232}Th-^{233}U$ breeding cycle. The calculations were made with respect to the minimum doubling time. The minimum doubling time was calculated as a function of various recovery methods assuming the presence of a breeder mantle. The results indicate that the graphite moderated Th high temperature reactor is not suitable as a breeder. (J.S.R.)

46858 (JUL–487-RW) WERKSTOFFE IN DER KONSTRUKTION DES MOSEL-REAKTORS. (Materials for the Construction of MOSEL Reactors). Metzger, G. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe). May 1967. 51p. (In German). Dep.

The construction materials used in liquid Pb and in fluoride salt melts at temperatures between 500 and 1,000°C are discussed. The insertion conditions of the construction materials in the reactor core and Pb surface in the latest version of the MOSEL reactor are indicated. The emphasis is on the mechanical properties, the processing, the corrosion resistance, and the nonscaling. The economy and nuclear physical properties are also considered. The metals Ni, Fe, V, Nb, Mo, and Ta were selected as the materials which had the best prospects as alloy bases for construction materials under these conditions. These metals and their alloys are discussed extensively from these viewpoints. Steel and Ni alloys are usable only in the low temperatures of the region from 500 to 1,000°C. For higher temperatures the high melting materials of V, Nb, Mo, or Ta must be used. These materials in comparison with steel and Ni alloys are less well known, more costly, and not scale free. The most suitable construction materials for general use appears to be Nb or its alloys. It is very difficult to make assumptions on V since its properties are too little known. Mo can be used when the problem of its extremely low ductility can be overcome. Ta would probably not be used since its disadvantages with respect to Nb outweigh its advantages. Present knowledge on the properties of these construction materials is not sufficient to permit their long time use in liquid Pb and fluoride salt melts especially at very high temperatures. Many technological problems remain unresolved. (tr-auth)

46859 (KFK–602) REVIEW OF SCATTERING LAW STUDIES FOR MODERATORS. Glaeser, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). July 1967. 34p. (CONF-670707–17). Dep.

From IAEA Symposium on Neutron Thermalization and Reactor Spectra, Ann Arbor, Mich.

Scattering law studies for moderators are presented. The various forms of the law consider the effects of chemical binding on slow neutron scattering. The basic formalism is reviewed; integral properties are presented. Experimental techniques are outlined. Applications of various scattering kernel models are made to water, ZrH, graphite and Be moderators. 77 references. (M.L.S.)

46860 (NP–17060) REPORT AND ACCOUNTS OF THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY FOR THE YEAR ENDED 31ST MARCH 1967 TOGETHER WITH THE COMPTROLLER AND AUDITOR GENERAL'S REPORT ON THE ACCOUNTS. Thirteenth Annual Report and Accounts, 1966–67. (United Kingdom Atomic Energy Authority, London (England)). July 26, 1967. 128p. Dep. CFSTI. UK 11s. 0d.

Activities in the United Kingdom which are discussed include: nuclear power economics; reactor development program; radioisotopes; and health and safety. (D.C.C.)

46861 (NUS–401) REACTOR OPERATION'S SAFETY ANALYSIS MONTHLY REPORT NO. 24, JUNE 1 TO JUNE 30, 1967. (NUS Corp., Washington, D. C.). Contract AT(11-1)-651. 50p. Dep. CFSTI.

For Rural Cooperative Power Association, Elk River, Minn.

Topics discussed concerning the operation of the Elk River Power Reactor include: secondary system and turbine air ejector radioactivity levels; liquid waste disposal; primary water chemistry and radiochemistry; core characteristics of the final loading pattern for the third fuel cycle of the Elk River Power Reactor; reactor heat flux; reactivity parameters; instrumentation and control; decay heat pump startup operation; and reactor vessel head fittings modification. (D.C.C.)

46862 (NYO–3530-1) STUDY OF ECONOMIC FEASIBILITY OF FAST BREEDER REACTOR PROTOTYPE IN NEW ENGLAND AREA. VOLUME I. ECONOMICS OF NUCLEAR POWER AND PLUTONIUM UTILIZATION UP TO 1985. (Jackson and Moreland, Boston, Mass.). Oct. 20, 1967. Contract AT(30-1)-3530. 224p. Dep. CFSTI.

For Holyoke Water Power Co., Mass.

Topics discussed include: principal utilities in New England; types of generation and transmission systems; economics of large fossil-fueled units for base load operation; economics of large nuclear-fueled plants; and practicality of breeders in the New England area. (D.C.C.)

46863 (ORNL–4145, pp 275–81) REACTOR EVALUATION STUDIES. (Oak Ridge National Lab., Tenn.).

Studies were made of various proposed advanced reactor and fuel-cycle systems to evaluate their technical and economic feasibility. Evaluations completed during the past year included estimations of the costs of fuel-material preparation (conversion), processing spent fuel, and shipping fresh and spent fuel for advanced converter reactors (HWOCR, HWBLWR, and HTGR), fast breeder reactors, and various proposed desalination reactors. In addition, computer codes were developed for analysis of the overall cost of nuclear power and for calculation of the decay properties of mixed fission products resulting from the fission of ^{235}U. Optimization of the size of fuel processing plants in a growing economy was also studied. (auth)

46864 (RT/FI–(67)16) PERTURBATION ANALYSIS OF FAST REACTORS BY THE CIAP AND GLOBPERT CODES USING IMPROVED PERTURBATION METHODS. Gandini, A.; Salvatores, M.; Sena, G.; Dal Bono, I. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1967. 25p. (CONF-661019–11). Dep.

From International Conference on Fast Critical Experiments and their Analysis, Argonne, Ill.

New techniques for perturbation analyses are presented. Some applications of these techniques are outlined. In the multigroup

diffusion approximation method, the CIAP code for calculation of the importance function as a function of specified linear variables; the GLOBPERT code uses this importance function in the perturbation formulations. An application to fast reactor systems is presented; calculations for Na void coefficient, Doppler coefficient, and total and internal breeding ratios are performed. (M.L.S.)

46865 (WASH–1076, pp 73–81) USE OF REACTOR CALCULATIONS AS APPLIED TO SAFEGUARDS. Kern, R. (Combustion Engineering, Inc., Windsor, Conn. Nuclear Div.).

The feasibility of using reactor calculations as a means to material safeguards was investigated. A calculational method, ISOCHECK, for a fuel-accounting tool, accuracies obtainable by this method, and setup of the method for 17 specific reactors are discussed. The steps required for setup and use of the ISOCHECK method for a given power reactor are shown. The FLARE code, for computation of the three-dimensional power and exposure distributions using an effective one-group nodal model, was used for calculation of assembly exposures. Accuracy of the method depends on reactor type and on the type of fuel used in the core. (M.C.G.)

46866 (WASH–1076, pp 82–6) CLANDESTINE DIVERSION OF SOURCE NUCLEAR MATERIALS IN A POWER REACTOR. Hoehn, William E. (RAND Corp., Santa Monica, Calif.).

Potential methods for diversion of source materials from a power reactor are discussed along with incentives for diversion, returns from limiting diversion opportunities, and appropriate cost levels. (M.C.G.)

46867 (WCAP–3269–59) DESIGN, FABRICATION, AND IRRADIATION OF A SAXTON SPECIAL 9 x 9 ASSEMBLY. Mattis, A. F.; McClintock, D. R. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). May 1967. Contract AT(30-1)-3269. 43p. Dep. CFSTI.

A special 9 × 9 assembly was irradiated in the Saxton reactor to obtain statistically significant data on prototype designs and materials considered for use in a large plant chemical shim environment. The assembly operated as part of the reactor core for a total of 155 effective full-power days at a maximum heat flux of 525,000 Btu/hr-ft^2. The assembly experienced a peak burnup of ~8,000 MWd/MtU and a corresponding fast flux exposure (>1 MeV) of 1.0×10^{21} nvt. In-pile performance was satisfactory and a visual examination revealed no anomalies. Exposure did not increase the force required to move the RCC absorber rods. (auth)

46868 (WCAP–3385–12) SAXTON PLUTONIUM PROGRAM SEMIANNUAL PROGRESS REPORT FOR THE PERIOD ENDING JUNE 30, 1967. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Contract AT(30-1)-3385. 36p. (EURAEC–1877). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

The purpose of the Saxton Plutonium Project is to develop information concerning the utilization of Pu enriched fuel in pressurized water reactor systems through design, fabrication and operation of a partial core of PuO_2–UO_2 in the Saxton reactor. In-pile performance of this fuel will be evaluated and post-irradiation examination of fuel samples will be made. Performance will be analyzed and compared with analytical predictions. (auth)

46869 (WCAP–6083) YANKEE CORE EVALUATION PROGRAM SEMI-ANNUAL PROGRESS REPORT FOR THE PERIOD ENDING MARCH 31, 1967. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Aug. 1967. Contract AT(30-1)-3017. 83p. Dep. CFSTI.

A recently approved extension of the Yankee Core Evaluation Program was initiated to determine experimentally and analytically the concentrations of many isotopes of interest in spent Yankee fuel which were not determined during earlier phases of the program. The buildup of ^{232}U and ^{233}U and their precursors is being investigated so that radiation problems involved in the enrichment of spent fuels can be better anticipated and planned for. The buildup of transuranic isotopes of economic value as fuel for isotopic power generators, such as ^{238}Pu and ^{244}Cm and their precursors is being studied to develop information needed for a complete evaluation of the feasibility and economic merits of using fuel discharged from commercial power reactors as a source of supply. Finally, the concentration of the stable fission product ^{148}Nd is being measured in spent Yankee fuel to determine if it is practical to use this isotope as a means of estimating fuel burnup with improved accuracy and precision. Evaluation of mass spectrometric data from spent fuel analyzed previously in this program continued with the development of a method by which cross section ratios of certain important U and Pu isotopes can be inferred. Preliminary application of this method to calculated isotopic data confirmed the adequacy of the technique. Application of the same method to measured isotopic data showed that a valid comparison between measured and calculated cross section ratios can be made only if fuel temperature and its effect on neutron spectrum are properly accounted for. (auth)

46870 (WCAP–6084) ENGINEERING AND METALLURGICAL EVALUATION OF THE YANKEE CORE I SPENT FUEL. Paxson, E.; Smalley, W. R. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). June 1967. Contract AT(30-1)-3017. 147p. Dep. CFSTI.

The engineering and metallurgical evaluation of spent fuel from Core I of the Yankee Reactor was a portion of the Yankee Core Evaluation Program. The general purposes of the evaluation were to confirm the suitability of the design and materials used, to determine the irradiation stability of the core components, and to compare predicted with actual performance. Sixteen fuel assemblies were subjected to visual and dimensional examinations and 71 fuel rods from these assemblies were subjected to various visual, dimensional, and metallographic examinations, and mechanical property tests. Evaluation of the results of these examinations led to the following basic conclusions: (a) The overall performance of the Yankee Core I fuel assemblies was excellent. (b) The fuel assemblies and fuel rods were dimensionally stable even for extended exposure to peak burnups of 40,000 MWD/MTU. (c) The UO_2 fuel and Type 348 stainless steel cladding performed satisfactorily up to 46,000 MWD/MTU and neutron doses to 8×10^{21} n/cm^2 (>1 MeV). (d) None of the changes in the dimensions or properties of the fuel assemblies, cladding or fuel were sufficiently large to define any operational limits for fuel assemblies in environments similar to that in Yankee. (auth)

46871 (EURFNR–353) SODIUM BOILING AND FAST REACTOR SAFETY. Peppler, W.; Schlechtendahl, E. G.; Schultheiss, G. F.; Smidt, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Translation of report KFK–612. 24p. Dep.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

For fast Na cooled reactor safety analysis liquid metal superheat and coolant flashing is very important. Investigation of the ejection mechanism with the digital code BLOW shows good agreement with experimental results. Present knowledge on Na superheat is reviewed and discussed, especially to demonstrate the great differences in experimental data; from this a research program is established. Also recondensation effects with their high pressure peaks are investigated; theoretical and experimental results are presented. (auth)

46872 (ORNL-tr–1773) EFFECT OF NUCLEAR POWER PLANTS ON THEIR ENVIRONMENT. Hejj, Attilla. Translated for Oak Ridge National Lab., Tenn., from Energ. Atomtech., 20: 75-81(1967). 23p. Dep. CFSTI. JCL $2.60 fs, $0.89 mf.

A nuclear power plant is considered as a plant producing radioactive waste. Several operational experiences gained in connection with the disposal of liquid radioactive wastes are presented. The formation and composition of gaseous radioactive wastes are discussed. The handling of radioactive dust and gases is considered. The discharging into the atmosphere of radioactive air and the factors influencing the movement of contamination are discussed. The resulting concentration is calculated. The evaluation of the plant location in terms of safety is described. Considerations related to determining the size of the exclusion zones to be used at the power plant are presented. (auth)

46873 THERMAL BEHAVIOR OF LAMINATED FUEL ELEMENTS IN NONSTATIONARY REGIME. Altieri, P. (Facolta di Ingegneria, Pisa, Italy). Termotecnica (Milan), 21: 269-73(May 1967). (In Italian).

The thermal behavior of laminated fuel elements in nonstationary regime is analyzed for the condition occurring after the total interruption of the coolant flow. The calculations are made on the basis of a laminate of finite thickness. (J.S.R.)

46874 DEVELOPMENT TRENDS IN NUCLEAR ENERGY. Wirtz, Karl (Technische Hochschule, Karlsruhe, Ger.). At. Strom, 13: 85-93(July-Aug. 1967). (In German).

After a review of the development of nuclear energy and the special conditions in the German Federal Republic, more detailed consideration is given to the types of nuclear reactors which are at present used in nuclear power stations. Light is thrown on the limits to their development. This leads to a discussion of future reactor types, in particular of breeder reactors. Here German, English and American development is paid special attention. The advantages and difficulties with individual breeder variants are compared. Finally, fuel supply in the Federal Republic is dealt with. (auth)

46875 CLASSIFICATION SCHEME FOR NUCLEAR REACTORS. At. Strom, 13: 104-11(July-Aug. 1967). (In German).

The compilation corresponds to the draft specification DIN 25,402 which was issued a short time ago. It was drawn up by Working Committee 1 "Terminology" of Technical Committee "Nuclear Engineering" (FNKe/AA 1) and it is in general agreement with the provisional reactor classification of the International Standards Organization (ISO), TC 85/SC1, in the work of which FNKe/AA 1 took part. (auth)

46876 HYBRID CALCULATOR FOR SIMULATION OF NUCLEAR REACTOR PROCESSES. Paul, Manfred. Elektrotech. Maschinenbau., 84: 8-12(Jan. 1967). (In German).

A combined analog-digital device for approximating processes in nuclear reactors is described. General equations are developed by the use of Laplace transforms and block diagrams are given for the circuitry describing delayed electrons and the general features of the reactor. The exponential increase of neutrons is approximated by a step function. Solutions for practical systems are illustrated, with equations developed for the frequency function. Comparison of the various time constants employed shows that the induction time and the second order delay time constant are both about an order of magnitude smaller than the first order delay constant and the integral time. Comparison between calculated and observed results show agreement to within 10%. (BBB).

46877 ANALYSIS OF THE MUTUAL INTERACTION OF CIRCUMFERENTIAL CONTROL PLATES. Spinks, N. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nucl. Sci. Eng., 30: 182-7(1967). (AAEC/TM-367).

From an empirical choice of the shadowing of one control-plate element by another, expressions are derived for the reactivity worth of systems of circumferential control plates. The expressions contain three parameters which are determined when independent calculations of three control systems have been made. The parameters can be expressed in terms of the worth of the complete control plate, the increase in reactivity due to unshadowing of an end of a control plate and the decay constant of the assumed exponentially decaying shadowing function. Application of the expressions to a particular reactor design, where circumferential control plates separate core from radial reflector, shows that the analysis is accurate for those situations where the number of control plates is not large. The analysis neglects neutron absorption by the edge of a control plate so that it underestimates reactivity worth in situations involving large numbers of control plates where the surface area of the plate edges becomes significant. (auth)

46878 NEW FUEL-ELEMENT DESIGN BOOSTS REACTOR RATING. Elec. World, 167: 25-8(Jan. 30, 1967).

Newly designed fuel elements for use in the Indian Point (New York) nuclear generator plant are described. Refueling of the plant was accompanied by replacement of the original fully enriched, thorium-oxide coverter core with a new one of slightly enriched uranium oxide. The new core design permits a 15-MW(e) increase in plant output, up to the full capability of the turbine generator. Refueling and maintenance required a 157-day outage from shutdown to initial criticality, 110 days of which would have been required for refueling and associated steps. Fuel handling during future outages is expected to require only about 42 days, however, as it will consist of replacing only the spent fuel and changing the remaining ⅔rd into regions requiring lower enrichment about once a year. A description is given of the refueling process and the remotely operated, semi-automatic fuel-handling system provided for this operation. The system consists of a traveling fuel-handling tool in the containment sphere above the reactor, transfer baskets for fuel elements and other components, a winch-operated shuttle that transports the baskets up or down the transfer tube between the containment sphere and the fuel-handling building, and a second handling tool for moving baskets to pools in the storage building. The new core was fueled with uranium oxide and required an average ^{235}U enrichment of only 3.40% on the first cycle. The low initial enrichment coupled with its production of Pu (presently considered cheaper and easier to reuse than ^{233}U) offered an advantage over the old core in burnup and use charges and a greater value as a source of reprocessed fuel. Inspection and maintenance of other reactor components during refueling, and shipping precautions for the spent fuel are also described. (BBB)

46879 ENTRY INTO THE WINDSCALE ADVANCED GAS-COOLED REACTOR PRESSURE VESSEL. Howells, G. R. (United Kingdom Atomic Energy Authority, Windscale, Eng.); Prince, K. J. Brit. Nucl. Energy Soc., 6: 241-8(July 1967).

The operators of the Windscale advanced gas-cooled reactor entered the main pressure vessel and carried out the first general inspection of the region within the upper dome in the vicinity of the hot box, without removal of irradiated fuel from the reactor. This was made possible by the upper neutron shield, which is a feature of the AGR design. The design of this shield, and the inspections carried out within the vessel, are described, and the measured dose rates are compared with the original estimates. It is concluded that these measurements have confirmed the effectiveness of the shield, and that the anticipated increase in dose rates will be sufficiently small to permit further inspections over the life of the reactor. (auth) (UK)

46880 NUCLEAR POWER FOR ITALY. Angelini, A. M. (Ente Nazionale per l'Energia Elettrica, Rome). Nucl. Eng., 12: 676-7(Sept. 1967).

The Italian nuclear power programme is reviewed. Future developments are considered in relation to the probable energy demands and to the energy resources of the country. It is expected that nuclear stations will be ordered at an average rate of at least 650 MW a year. The place of advanced reactors and pumped storage in the future pattern is discussed. (UK)

46881 THREE ON-LINE: [NUCLEAR STATION EXPERIENCE IN ITALY]. Nucl. Eng., 12: 691-3(Sept. 1967).

Experience is reviewed in the operation of the Latina, Garigliano, and Trino Vercellese power stations. In spite of the troubles encountered, which are described, all three stations have been found very valuable assets in the network. (UK)

46882 BRITAIN'S HEAVY-WATER REACTOR. Engineering, 204: 411-15(Sept. 15, 1967).

The Steam Generating Heavy Water Reactor SGHWR design is discussed in relation to its capabilities and its place in the UK reactor development programme. The 300 MW(e) Winfrith prototype which is described is a direct cycle pressure tube design with Zircaloy-clad enriched UO_2 fuel. Turbine steam conditions are 279°C and 900 psi. Radiation shielding is provided for the high-pressure end. Power level is controlled by variation of the moderator level. (UK)

46883 WEIGHTING FACTORS FOR EXPERIMENTAL REACTOR SAFETY STUDIES. Vinck, W. F. Nucl. Eng., 12: 696-9(Sept. 1967).

It is suggested that a balance must be found between the acceptance of operational risk based on design and inspection, and the expenditures on theoretical and experimental analysis of potential accidents. The types of accident discussed from this point of view, relating principally to water reactors, are loss-of-coolant and severe reactivity transients caused by control rod drop, fuel handling, and control rod ejection. (UK)

46884 OSKARSHAMN POWER REACTOR. Leine, L. (Aktiebolaget Atomenergi, Vaesteras, Sweden). Tek. Tidskr., 97: 371-8(Apr. 1967). (In Swedish).

The Oskarshamn power reactor is a boiling reactor using enriched U and moderated and cooled by water. Thermal data are given. The core, pressure vessel, containment, cooling system, fuel exchange and purification equipment are briefly described. (SWED)

46885 FAST BREEDER REACTORS IN WESTERN EUROPE. Haehnel, S. Tek. Tidskr., 97: 803-10(Sept. 1967). (In Swedish).

The development programs for fast breeder reactors in Great Britain, France, West Germany, Italy, and Sweden are summed up. Cooling with Na and steam is compared. The fuel is discussed in terms of supply, doubling time, fabrication, cladding, handling, and reprocessing. Data on some breeder reactor prototypes and a commercial breeder reactor are given. (SWED)

46886 THERMODYNAMIC EQUILIBRIA IN SODIUM-AIR SYSTEMS. Leibowitz, L. (Argonne National Lab., Ill.). J. Nucl. Mater., 23: 233-5(1967).

Calculations were carried out for equilibrium pressures and temperatures generated during Na combustion in Na-air and Na-air-water mixtures. A computer program designed to minimize free energy was used to verify and improve the precision of previous calculations, and to extend the calculations to include the effect of added water. (H.D.R.)

46887 ELASTIC-MECHANICAL ANALYSIS OF THE LOWER PLATE HEAD OF THE CIRENE PROTOTYPE REACTOR. Crucitti, N. (Ansaldo Meccanico Nucleare, Genoa). Energ. Nucl. (Milan), 14: 519-29(Sept. 1967).

The elastic-mechanical behaviour of the lower plate head of the CIRENE prototype reactor is considered. A preliminary structural analysis is performed by means of analytical solutions neglecting the internal constraints. A numerical method is then applied taking such constraints into account; the bending moment diagram and the load-deflection curves, considered as more significant, are obtained by electronic computer. A comparison is made between the results of both methods. (auth)

46888 A HYBRID COMPUTER FOR SIMULATION OF NUCLEAR REACTOR EVENTS. Paul, Manfred (Technische Hochschule, Vienna). Elektrotech. Maschinenbau., 84: 8-12(Jan. 1967). (In German).

The author describes an analog-digital computer for solution of differential equations with nonconstant coefficients that describe events in a nuclear reactor operating with slow neutrons. An expression for the frequency flux of a thermal reactor without reflector, based on the stationary value of the neutron density is derived for specified limits. Simplified block diagrams of the analog networks, exponential curve for reactor and calculator, and mathematical formulations are shown. Results from use of the computer are compared with values taken from neutron density measurements. The equipment is illustrated. The results indicated that use of hybrid computer technique has important advantages for the construction of a nuclear reactor simulator. (BBB)

46889 OBRIGHEIM, THE KWO NUCLEAR POWER STATION WITH A SIEMENS PWR. Lepie, G. M.; Martin, A. H. (Siemens-Schuckertwerke AG, Erlangen, Ger.). Nucl. Eng., 12: 278-85 (Apr. 1967).

Construction of the 300 MW(e) plant described commenced in March 1965 and trial operation is scheduled for summer 1968. The core contains 35.2 ton U in the form of 3% enriched UO_2 clad in Zircaloy-4. Reactivity is controlled by H_3BO_3 and a rod cluster control system using Ag–In–Cd alloy in austenitic tubes. The cylindrical stainless steel clad carbon steel reactor vessel 3.27 by 9.83 m, is designed for 175 atm. Heat is transferred from the core by water at 145 atm flowing at 22,000 ton/h in two parallel circuits with inlet and outlet temperatures of 283°C and 310.4°C. The vertical U-tube steam generators with integral steam drums provide steam to the tandem-compound 3,000 rpm turbine at 48.7 atm. (auth) (UK)

46890 CIRENE PROTOTYPE REACTOR. Casagrande, I. (Centro Informazioni Studi Esperienze, Milan). Nucl. Energy, 12: 685-90(Sept. 1967).

The 35MW(e) reactor which is described is a heavy water moderated, boiling light water cooled, natural uranium fuelled design. It is expected to be in operation in 1972. The supporting research and development programme covering the problems of the fuel assembly, thermohydraulics, control, and reactor physics is reviewed. (UK)

46891 UTILITIES COLLABORATE IN 1618-Mw NUCLEAR STATION. Michelson, E. L. (Commonwealth Edison Co., Chicago); Weise, W. H. Elec. World, 168: 32-3(July 17, 1967).

A description is given of the design, specifications, and construction of the 1618-MW Quad-Cities Nuclear Generating Station. The station will have 2 nuclear units of the boiling-water reactor type, each of an ultimate rating of 809 MW. Following comparisons, results showed that nuclear capacity installed cost would be about 10% less than that of a coal-fueled plant. The boiling-water, single-cycle reactors will have forced circulation, in which reactor steam will be used directly in the steam turbine. The reactor core will contain 724 fuel assemblies of UO_2 clad with Zircaloy. Primary containment consists of a dry well and a pressure-suppression chamber. A new feature will be jet pumps operating within the reactor pressure vessel as a part of the coolant circulation system. (J.C.W.)

46892 TVA'S FIRST NUCLEAR PLANT. Palo, George P.; Weaver, Donald B. Power Eng., 71: 38-42(Apr. 1967).

General design features of the Browns Ferry nuclear power plant with 2 nuclear units, each with a guaranteed rating of 1098 Mw(e) and an expected capacity of 1152 Mw(e) are discussed. The station, a floor plan, and a cross-section through the unit are illustrated. The design provides a means of maintaining the auxiliary equipment while the unit is on-line. This is the first nuclear plant with turbine drives for feedwater pumps. New design features are elimination of the stretch concept, increase in reactor core power density, and 2 units being built simultaneously with start-up dates a year apart. Design also provides for short-term peaking power by removing the highest-pressure feedwater heater from service, thus increasing the flow through the remainder of the turbine to obtain still more power. This does not increase the flow through the reactor, but does require additional thermal output because of the lower temperature of the entering feedwater. How the higher core-power density is a direct result of new heat-transfer correlations and improved power distribution is explained. (J.C.W.)

46893 THE SWEDISH NUCLEAR POWER STATION, MARVIKEN. Skowronek, M. (Ingenieurschule, Hamburg). Brennst.-Waerme-Kraft, 19: 407-17(Aug. 1967). (In German).

The nuclear power station at Marviken is described. The reactor and its components are mentioned as well as the turbine, condenser, preheater, piping, and the parts of the machine building. The special problems arising from the use of heavy water and the safety measures for the superheater are discussed. (auth)

46894 NUCLEAR POWER: THE NEXT DECADE OF DEVELOPMENT. Shaw, Milton (Atomic Energy Commission, Washington, D. C.). IEEE (Inst. Elec. Electron. Eng.), Spectrum, 4: 73-80(Oct. 1967).

An evaluation of the role of nuclear energy in power production is given. Central power stations in the U. S. and Puerto Rico are listed according to geographical location. Generating capacity of nuclear power plants is presented as a function of year. Predictions are given for the next decade. (M.L.S.)

46895 MAKING USE OF PLUTONIUM AS A REACTOR FUEL. Williams, J. A. (United Kingdom Atomic Energy Authority, London). Elec. Rev., 180: 475(Mar. 31, 1967).

Several aspects of use of Pu for fuel in reactors which use moderated or thermal neutrons to achieve nuclear fission are presented. It can also be used in the fast reactors now being developed. Plans for Pu fuel fabrication will outstrip the Pu available in the mid-1970's. The reprocessing of Pu-enriched fuels by the volatility method is discussed. The volatility method converts U and Pu into the gases PuF_6 and UF_6, which are separated from fission products and each other by taking advantage of differences in vapor pressure and rate of reaction relations. (J.C.W.)

46896 ELECTRONUCLEAR CENTERS IN CANADA. Gray, Lorne (Atomic Energy of Canada Ltd., Ottawa). Genie Civil, 144: 122-4(Feb. 1967). (In French).

Plans are described for construction of a 250-Mw(e) nuclear power plant, at Gentilly, of the CANDU-BLW type. Studies are described which have been made with the reactor types CANDU-PHW (Canadian Deuterium Uranium-Pressurized Heavy Water) and at the NPD (Nuclear Power Demonstration) center relating to constructing of new reactors. A history of reactor development in Canada is given. Relative costs of production and construction are analyzed. (J.C.W.)

46897 WHOSE REACTOR IS THE BEST. Engineering, 203: 718(May 5, 1967).

Economic features of reactor systems being developed in the United States and United Kingdom are contrasted. In an appraisal of 3 AGR designs, 1 BWR, and 4 PWR designs, the AGR scored highest in the final cost, which included initial and replacement fuel charges and an availability adjustment. After an examination of the validity of economic claims made for the AGR, also considered are the cost differences between British and U. S. plants of similar design. Costs of U. S. reactor types are much higher in the U.K. than in either the U. S. or Germany. (J.C.W.)

46898 REMOTE SITING OF NUCLEAR POWER NO LONGER A NECESSITY. Adams, C. A. (Central Electricity Generating Board, London). Elec. Rev., 180: 588-90(Apr. 21, 1967).

Progress in development of nuclear reactor containment structures allows more liberal siting policies for power reactors. The basic concepts of maximum credible accident, probability approach, and containment are defined. Considerable meteorological work must be undertaken to assess population doses in the event of the maximum hypothetical accident. The siting and design assessment require investigation regarding earthquakes. The containment is not regarded as subject to cross-connected faults but is required to have independent unreliability not greater than 0.003. Some standards applicable in different countries are stated. (J.C.W.)

46899 ONLY BREEDER CAN MAKE REACTOR INDUSTRY VIABLE. Wright, James H. (Westinghouse Electric Corp., Pittsburgh). Elec. World, 167: 45-7(May 29, 1967).

Aspects of breeder reactor development discussed include advanced converters, breeder reactor goals, significance on U ore requirements, high or low gain breeder reactors, fuel costs, effect of Pu utilization, reactor types, and economics of breeder reactors. Projected (1985) economics for pressurized water and Na fast breeder reactor plants of 2000 Mw(e) capacity are contrasted. Some technical and economic problems to be solved before breeder reactors reach the commercial stage are discussed. When it has reached economic fruition, the breeder will not displace all other reactor types. Because of its economic characteristics of high capital and low incremental costs, it will serve primarily in the base load application of utility systems. (J.C.W.)

46900 NUCLEAR REACTOR DESIGN CHECKED WITH SCALE MODELS. Westinghouse Eng., 27: 125(July 1967).

Reactor internal flow design is evaluated by the use of scale models. Described and illustrated is a $\frac{1}{7}$ scale model of the

internal components of the pressurized-water Indian Point-2 nuclear power plant. It is scheduled for commercial operation in 1969. The 4-loop plant will have a gross capacity of 873 Mw(e). (J.C.W.)

46901 NUCLEAR SAFETY. Volume 8, Number 5. Cottrell, Wm. B.; Jordan, W. H.; Blakely, J. P.; Savolainen, A. W. (eds.). Contract W-7405-eng-26. One of the Five Quarterly Technical Progress Reviews Published for the Division of Technical Information, USAEC. Oak Ridge National Lab., Tenn., Sept.-Oct. 1967. 110p. GPO $1.00 Domestic, $1.20 Foreign.

A technical progress review of the state-of-the-art of nuclear safety is presented. Subjects covered include: technology of steel pressure vessels for water-cooled nuclear reactors, nuclear transportation, CABRI: a test reactor for safety studies, radiation damage to pressure vessel steels, reliability analysis of engineered safeguards, reliability estimates and reactor safety system operation, containment integrity: a state-of-the-program report, atmospheric transport and diffusion at coastal sites, progress summary of nuclear safety research and development projects, action on reactor and other projects undergoing regulatory review or consideration, and changes in licensing regulations. Separate abstracts are prepared for each of the eleven subjects listed above. (M.L.S.)

For abstracts of individual sections see: 45251, 46902–46908, 46951, 46969, and 46970.

46902 NUCLEAR TRANSPORTATION. Thompson, J. Trueman; Morgan, James M. Jr. (Johns Hopkins Univ., Baltimore). Nucl. Safety, 8: 443-54(Sept.-Oct. 1967).

A review of nuclear transportation research performed under the cognizance of the USAEC was accomplished in 1964 and reported in 1965. This paper summarizes the strengths and weaknesses of the research program under such accomplishments as symposia, criticality experimentation and analysis, and model testing. It also points out gaps in knowledge, neglected areas, and areas of duplication, as well as the effects of classification, lack of industrial participation and coordination, etc. Also discussed are some of the problems that give rise to the need for research. These are summarized under such headings as comparison of transportation modes, safety and its cost, criticality control, insurance, weight-cost relations, interchangeability, specialized services, relations with transportation groups, and regulations. Encouragements for the future are noted. 29 references. (auth)

46903 RELIABILITY ANALYSIS OF ENGINEERED SAFEGUARDS. Garrick, B. J.; Gekler, W. C. (Holmes and Narver, Inc., Los Angeles). Nucl. Safety, 8: 470-9(Sept.-Oct. 1967).

The requirements for assessing reliability in engineered safeguards are reviewed, an example of reliability analysis in a typical emergency core-cooling system is given, and a plan is presented for use of reliability techniques in nuclear systems safety analysis. Reliability can now be used in many ways in nuclear safety, but, before it can be a truly effective tool, certain additional requirements must be met. Relevant probabilistic models must be developed, and realistic statistical data are needed. Techniques exist for developing relevant models. Statistical data now derive largely from operating experience. These data, although of some use, must be improved to permit confidence in mathematical evaluation of reliability. The importance of reliability lies not so much in numbers generated as it does in requiring systematic guidance of safety analysis and testing and accident-prevention programs. 17 references. (auth)

46904 RELIABILITY ESTIMATES AND REACTOR-SAFETY-SYSTEM OPERATION. Scott, R. L. Nucl. Safety, 8: 479-82 (Sept.-Oct. 1967).

Two papers presented at the Winter 1966 meeting of the American Nuclear Society are summarized. One paper discusses data obtained from five power-reactor operating agencies in order to make reliability estimates. Since the data were obtained for purposes other than reliability prediction, it has limited applicability. Reliability estimates are presented for emergency core-cooling systems, energency power systems, and secondary shutdown systems. The other paper discusses reactor-safety-system operation data obtained from the same five power-generating plants. The composite data indicate that real and spurious scram rates are each between five and six per year. Most of these scrams occurred at low reactor power and produced only one or two power-generation outages per year. (auth)

46905 CONTAINMENT INTEGRITY: A STATE-OF-THE-PROGRAM REPORT. Nucl. Safety, 8: 483-9(Sept.-Oct. 1967).

Several types of high-pressure containment systems may be utilized for water reactors: direct pressure, double or multiple wall, pressure suppression, or pressure relief. Maintenance of integrity of the containment structure requires that it be designed and constructed to withstand the temperatures and pressures resulting from coolant discharge in the maximum credible accident. Programs are currently under way or being proposed to study containment pressurization, containment-shell response, brittle fracture, containment-pressure reduction, leakage testing, missile and shock protection, and antiseismic design. 13 references. (auth)

46906 PROGRESS SUMMARY OF NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROJECTS. Whetsel, H. B. Nucl. Safety, 8: 500-18(Sept.-Oct. 1967).

Nuclear Safety research and development projects are summarized. These summaries concern: water reactor safety including reactor kinetics and related studies, integrity of primary systems, loss of coolant and containment response, fission product behavior under accident conditions, multipurpose experiments–such as the Containment Systems Experiment (CSE), Containment Research Installation (CRI), Safety-test engineering program (LOFT), support work–such as reactor vessel melt-through studies, fuel-heatup-simulation test program, theoretical studies of fission product release, LOFT chemical development, model tests of coolant blowdown, calculation of subcooled decompression time on a pressurized-water system following a primary-coolant loop break, and stresses under blowdown conditions; fast reactor safety including fast reactor studies, chemical reactions (fast sodium-cooled systems), vented fuel element development, transient testing of fuel, boiling studies for sodium reactor safety, reactor-dynamics simulator development, characterization of sodium fires and fission products, fission product release studies; gas cooled reactor safety including fission product behavior during steam-graphite reaction, fission product behavior tests in ORR, large-scale steam-graphite test, and ORR capsule tests on fission products at high temperature; effluent-control research and development program including Columbia River sediment studies, soil-moisture flow, laboratory and analytical studies of different shipping-cask types and materials, model-river-system studies, and reactor fuel transport safety, waste treatment and disposal program including dispersion of radioactive aerosols and gases in the atmosphere, removal of organic iodides from reactor containment atmospheres, development of analytical model to predict travel of radioactive gases discharged into the ground, and dispersion of radioactive gases injected into the ground; general safety studies including reactor operator study, RDT standards, and the Nuclear Safety Information Center. 45 references. (M.L.S.)

46907 ACTION ON REACTOR AND OTHER PROJECTS UNDERGOING REGULATORY REVIEW OR CONSIDERATION. Blakely, J. P. Nucl. Safety, 8: 521-34(Sept.-Oct. 1967).

A summary of action on reactor projects undergoing regulatory review is presented. Information is presented on Browns Ferry 1 and 2 (Dockets 50-259 and 50-260), Connecticut Yankee (Docket 50-213), CVTR (Docket 50-144), Dresden 2 and 3 (Dockets 50-237 and 50-249), Enrico Fermi (Docket 50-16), Fort Calhoun (Docket 50-285), Ginna 1 (Docket 50-244), Indian Point 1 and 3 (Dockets 50-3 and 50-286), La Crosse (Docket 115-5), Malibu (Docket 50-214), Monticello (Docket 50-263), Nuclear Merchant Ship N. S. Savannah (Docket 50-238), Oconee 3 (Docket 50-287), Pathfinder (Docket 50-130), Point Beach (Docket 50-266), Prairie Island (Docket 50-282), Robinson 2 (Docket 50-261), San Onofre (Docket 50-206), Surry 1 and 2 (Dockets 50-280 and 50-281), Three Mile Island (Docket 50-289), and Turkey Point 3 and 4 (Dockets 50-250 and 50-251). 50 references. (M.L.S.)

46908 CHANGES IN LICENSING REGULATIONS. Blakely, J. P. Nucl. Safety, 8: 534-6(Sept.-Oct. 1967).

Proposed changes in 10 CFR are summarized. Changes are proposed for the following sections: parts 10, 20, 30, 32, 40, 50, 70, 170, 31, 35, 115, 150, and 140. Comments on 10 CFR Parts 30, 40, 50, 70, 170 are given. 8 references. (M.L.S.)

46909 HEAT EXTRACTION DEVICE FOR A REACTOR. Vitry, Pierre (to Societe Indatom). British Patent 1,088,787. Oct. 25, 1967. Priority date July 9, 1965, France.

The design for a heat extraction device for gas-cooled reactors of the integral exchanger type is presented. Since the coolant, reactor core, and heat exchangers are all enclosed in a pressure vessel, there is a high level of contamination involved in removing or repairing a failed heat exchanger. The design described eliminates the need for entry inside the reactor for withdrawal of the exchanger. (D.C.C.)

46910 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTORS. Smith, Derek Randall (to Nuclear Power Plant Co., Ltd. A.E.I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 1,088,898. Oct. 25, 1967. Filed Nov. 19, 1965.

The design of a light water-cooled, heavy water-moderated reactor is presented. To prevent undesirable neutron absorption

by pressure tubes which contain the reactor fuel, the fuel is located in internal tubes of the calandria so as to leave spaces between the fuel and the internal surfaces of the tube walls. This requires that the pressure of the heavy water be maintained at or near the pressure of the light water which is allowed to flow between the fuel and tube wall. Inert gases are used to maintain the heavy water pressure. (D.C.C.)

46911 NUCLEAR REACTOR CONTROL MECHANISMS. Challender, Ronald Scott (to United Kingdom Atomic Energy Authority). British Patent 1,088,123. Oct. 25, 1967. Filed Dec. 30, 1964.

A design for using control rod drives for both normal reactor control operations and emergency shutdown operations is presented. The mechanism described is to be used in a pressurized water reactor having a core comprising a number of similar fuel element assemblies. (D.C.C.)

46912 SHOCK ABSORBER FOR REACTOR SAFETY RODS. (to Gesellschaft fuer Kernforschung mbH). British Patent 1,088,916. Oct. 25, 1967. Priority date May 13, 1964, Germany.

The design of a shock absorber for slowing down the entrance movement of safety rods in gas-cooled reactors by compressing a volume of gas is presented. The design consists of a piston and cylinder arrangement with at least one gas expansion opening located at a predetermined deceleration point in the cylinder on reversal point of the piston. (D.C.C.)

46913 FUEL ROD STRUCTURE. (to Atomic Energy of Canada). British Patent 1,088,894. Oct. 25, 1967. Priority date Aug. 28, 1964, Canada.

The design for a fuel bundle consisting of clustered elements comprising fuel materials with Zircaloy-2 cladding is presented. The use of Zircaloy-2 warts between the surfaces of the fuel elements prevents longitudinal deformation in the clustered configuration. (D.C.C.)

46914 MODAL APPROXIMATIONS. THEORY AND AN APPLICATION TO REACTOR PHYSICS. Stacey, Weston M. Jr. Research Monograph No. 41. Cambridge, Mass., The M.I.T. Press, 1967. 129p. $6.00.

General formalism for obtaining mathematical approximations to multivariable systems by means of modal expansions is presented. Methods for deriving the mathematical and physical significance of the approximate solutions are described. The general formalism is applied to obtain calculational models for the space-energy distribution of neutrons in fast reactors. (auth)

46915 NUCLEAR REACTORS. Bradley, Norman; Lawson, Donald Wilfred (to United Kingdom Atomic Energy Authority). British Patent 1,077,064. July 26, 1967. Filed Aug. 9, 1963.

A heavy water-moderated reactor is designed with an upper chamber in the calandria vessel through which is circulated part of the coolant moderator to prevent overheating of the top by nuclear radiation. (P.G.C.)

46916 IMPROVEMENTS IN NUCLEAR REACTORS. (to Kernforschungsanlage Julich Des Landes Nordrhein-Westfalen e. V.). British Patent 1,079,427. Aug. 16, 1967. Priority date Jan. 21, 1965, Germany.

In the high-temperature gas-cooled reactor described fuel particles are passed through rectangular graphite channels of the reactor core where heat is transferred by gas coolant. The spherical fuel particles, coated with carbon or carbides and consisting of fertile or fissionable material or mixtures of the two move through zones of increasing neutron flux until the desired burnup is achieved. At that point the particles are extracted from the reactor core and reprocessed. Different densities are obtained in the fuels by employing diluents as graphite and/or carbon black in bead form which are coated with pyrolytic carbon. (P.G.C.)

46917 IMPROVEMENTS RELATING TO POWER GENERATION FROM NUCLEAR REACTOR PLANT. Hutchinson, William George; Webb, John (to United Kingdom Atomic Energy Authority). British Patent 1,077,375. July 26, 1967. Filed May 28, 1963.

In a nuclear reactor, the fuel core containers, either separate vessels or compartments of a single vessel, are designed so that coolant flow from a common source is distributed in proportions sufficient to hold the maximum fuel element surface temperature at a given magnitude in both charges, and subsequently reversing the respective conditions of the charges to maintain a condition of criticality in one assembled charge of fuel elements while maintaining a condition of subcriticality in the other. The system, applicable to sodium cooled fast reactors, allows the fuel elements of the previously critical charge to dissipate decay heat until such time as discharge is desired. (P.G.C.)

46918 ARRANGEMENT FOR NEUTRON ECONOMICAL LONG-DURATION CONTROL OF NUCLEAR POWER REACTOR. (to Alfa-Laval Aktiebolag). British Patent 1,077,252. July 26, 1967. Priority date Jan. 20, 1965, Sweden.

A heterogeneous power reactor comprises a number of fuel elements which may be rotated, by outside operating devices, to vary the spacing between the elements and thus alter the quantity of moderator fluid between them. By changing the geometrical pattern of the fuel assembly in this manner compensation is made for the decrease in fissile isotopes and the increase in stable absorbing fission products, during operation of the reactor, and a more efficient conversion of fuel is obtained. (P.G.C.)

46919 IMPROVED METHOD OF OPERATING A NUCLEAR REACTOR. (to Atomic Energy of Canada). British Patent 1,077,385. July 26, 1967. Priority date Sept. 9, 1964, Canada.

In the nuclear reactor described, the fuel, an Al–U alloy in which a poison element, Cd, Gd, or Sm, is dispersed by solid solution, may be in the form of an annulus between an outer and inner coolant flow tubes, be comprised of multiple Al–U rods, or may be in the form of an outer and inner annulus. In operation of the reactor the fuel is allowed to regain normal reactivity by insertion into one stage of the reactor and subjecting it to neutron bombardment. It is then removed to allow poison buildup to again reduce reactivity after which it is inserted into a second stage, of lower neutron flux, where it is again subjected to neutron bombardment and normal reactivity is restored in a relatively short period compared to the life of the fuel in the first stage. (P.G.C.)

46920 CONTROL SYSTEM FOR FAST REACTORS. (to Hitachi Ltd.). British Patent 1,081,214. Aug. 31, 1967. Priority date Mar. 9, 1965, Japan.

To control reactivity in fast reactors, particularly those employing a $^{238}U-^{239}Pu$ fuel cycle, a system was devised for passing liquid control material through tubes, located in the core of the reactor, which contain an area near the periphery of the core through which the control liquid does not pass. The void created prevents a positive coolant coefficient of reactivity and eliminates sudden boiling of the coolant in the core. (P.G.C.)

46921 ATOMENERGIE HEUTE. (Atomic Energy Today). Michaelis, Hans. Munich, Verlag R. Oldenbourg, 1966. 74p. DM 16,-.

The present state and the development possibilities of nuclear energy techniques and the possibilities of its scientific utilization are outlined. The energy economic principles are outlined and the probable price evolution for fuel oil and coal are given. The rapidly expanding development of the electrical industry is outlined. The power reactors now in operation and under construction are tabulated. Installation cost and cost evolution of nuclear power plants using tested reactor types are examined. The future economics of these tested reactor types is discussed. The long range possibilities for the introduction of nuclear power plants into the power network are discussed. The nuclear energy program of the European Atomic Community is outlined. The supply of nuclear fuels and the safety of nuclear installations are considered. (J.S.R.)

46922 SAFETY SYSTEM FOR PRESSURE TUBE REACTORS. Costes, Didier (to Commissariat a l'Energie Atomique). British Patent 1,086,349. Oct. 11, 1967. Priority date July 2, 1965, France.

A safety system is designed for a pressure tube reactor through which a primary coolant fluid is circulated under pressure. The primary cooling circuit components and a discharge duct for connecting the containment vessel to the atmosphere have a volume at least equal to that of the gas released in the event of an accident if the gas released is at atmospheric pressure. (J.C.W.)

46923 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR SYSTEMS. (to General Dynamics Corp.). British Patent 1,078,318. Aug. 9, 1967. Priority date Sept. 14, 1964, United States.

A power reactor of the TRIGA type comprises a reactor core which includes an active area containing nuclear fuel material, such as U–ZrH, a circulating fluid, water, heavy water, or organic liquids, which acts as both coolant and moderator, and a fuel-free region. The nuclear fuel is specified to have a negative temperature coefficient of reactivity, the fluid in the circulatory system to have a predetermined positive density coefficient of reactivity, and the fluid in the fuel-free region to have a negative density coefficient of reactivity. The predetermined density coefficient of the circulating fluid is so selected that changes in operating conditions or a variation in the power load on the reactor is automatically compensated for within the reactor without causing an accident. (P.G.C.)

46924 IMPROVEMENTS IN OR RELATING TO PRESSURIZED NUCLEAR REACTOR INSTALLATIONS. Windle, Geoffrey Vincent; Bradley, Norman; Johnson, Frank Geoffrey (to United Kingdom Atomic Energy Authority). British Patent 1,081,673. Aug. 31, 1967. Filed Dec. 16, 1963.

An installation designed to prevent escape of radioactive contaminants from a pressurized reactor, if the containing vessel is breached, comprises a chamber containing the reactor and an outer chamber containing a pool of liquid where solid and condensable contaminants are segregated. Pressure sensitive valves, bursting panels, and fluid flow ducts are incorporated in the system as are means for decontamination and recharging of fuel. (P.G.C.)

46925 CONTROL OF NUCLEAR POWER REACTORS. (to Atomic Energy of Canada Ltd.). British Patent 1,080,384. Aug. 23, 1967. Priority date Aug. 31, 1964, Canada.

A control device for a nuclear power reactor comprises a number of vertical control elements consisting of axially-spaced chambers filled with a neutron-absorbing liquid or gas which are inserted in the reactor core. The neutron-absorbing capability is varied, in the case of a liquid, by adjusting the volume of liquid in the chambers or by varying the concentration of neutron absorbent. If a gaseous neutron-absorbent is used, means are provided for varying the density of the gas, and the neutron-absorbing capability, by changing the pressure. (P.G.C.)

46926 NUCLEAR REACTOR FUEL ELEMENT ASSEMBLIES. Saunders, Alan Charles Anthony (to United Kingdom Atomic Energy Authority). British Patent 1,081,281. Aug. 31, 1967. Filed Aug. 11, 1964.

A fuel element assembly for a heavy water-moderated reactor comprises a transverse bracing grid of deformed stainless steel strips with opposed protuberances which provide rigid pads to brace the fuel rods, ensure accurate spacing, and allow maximum flow of coolant. (P.G.C.)

46927 NUCLEAR FUEL CARTRIDGE. Costes, Didier (to Commissariat a l'Energie Atomique). British Patent 1,079,308. Aug. 16, 1967. Priority date June 18, 1965, France.

A nuclear fuel element, for use in power reactors cooled by gas or high pressure steam, consists of plates of clad fuel material in alignment parallel to the axis of the cooling channel, and a sliding graphite moderator sleeve which engages the channel wall and abuts against the sleeves of adjacent fuel cartridges to delimit the passageway of coolant flow. Devices to support the assembly and prevent lateral movement are presented. (P.G.C.)

46928 MINIMAL GAS PRODUCING LOW DETONATION RATE EXPLOSIVE AND DETONATION SOURCES. (to United States Atomic Energy Commission). British Patent 1,079,583. Aug. 16, 1967. Priority date Oct. 2, 1964, United States.

Explosives designed to simulate nuclear reactor runaways incorporate minor proportions of high explosives such as PETN, HMX, RDX, or tetryl, with perchlorates or B, and leaf, flake, or platelet Al. The explosive is characterized by a low detonation rate, minimal gas production, and large amounts of solid and liquid by-products. (P.G.C.)

Marine and Portable Power Reactors

Refer also to abstract 45286.

46929 (SC-CR-67-2746) OPTIMAL NUCLEAR REACTOR CONTROL. Technical Report EE-142. Mohler, R. R.; Price, H. J. (New Mexico Univ., Albuquerque. Bureau of Engineering Research). Aug. 1967. Contracts AT(29-1)-789; 53-4757. 162p. Dep. CFSTI.

For Sandia Corp., Albuquerque, N. Mex.

Topics discussed include: theoretical aspects and numerical calculation of optimal controls with the maximum principle for the nuclear rocket reactor; potentially singular subarcs for the nuclear rocket reactor; and linear programming with MPS 1360. (D.C.C.)

46930 VULCAIN, A PRACTICAL PROPOSITION. Storrer, J. (Societe Belge pour l'Industrie Nucleaire, Brussels). Nucl. Eng., 12: 293-7(Apr. 1967).

The experience gained to date in the development, building, commissioning, and operation of the 11.45 MW(e) BR3/Vulcain experiment is surveyed. The experiment is being used to test the variable moderator (D_2O/H_2O) PWR concept for power reactors in the 20 to 100 MW(e) range. A load factor of 92.7% has been achieved during the first 2½ months of satisfactory operation. The only major interruption was caused by the leaking of a pressurizer safety valve. (auth) (UK)

46931 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Taylor, Anthony James (to Babcock and Wilcox Ltd.). British Patent 1,081,190. Aug. 31, 1967. Filed June 21, 1965.

A small size reactor, liquid cooled and moderated, for use in marine vessels, consists of a pressure vessel containing a hexagonal core composed of wedge shaped fuel element assemblies surrounded by banks of heat exchanger tubes. The core is provided with inlet and outlet cooling ports, control rods, and lifting devices. The entire assembly is supported on ledges of the pressure vessel and is fitted with lifting and positioning lugs. (P.G.C.)

46932 NUCLEAR REACTOR CONTROL MECHANISM. Challender, Ronald Scott (to Societe Anglo-Belge Vulcain, S.A.). Brisith Patent 1,080,831. Aug. 23, 1967. Filed Jan. 17, 1964.

A fluid-operated piston and cylinder control mechanism for a pressurized water marine propulsion reactor is mounted in a casing secured above the reactor core and serves to raise a neutron-absorbing member out of the core while having the capability of accelerating the movement of the member into the core during any uncontrolled incident in the reactor operation. (P.G.C.)

46933 NUCLEAR REACTOR. Challender, Ronald Scott (to Societe Anglo-Belge Vulcain S. A.). British Patent 1,076,978. July 26, 1967. Filed Jan. 28, 1964.

A pressurized water reactor designed for maritime use is described which consists of a reactor core, coolant circuit, heat exchangers, and a reactivity control mechanism wherein venturi tubes are connected in parallel flow with part of the circuit and the control mechanism to render the control mechanism responsive to a pressure differential between the coolant in the circuit and the coolant in the venturi throat. (P.G.C.)

Rocket and Space Reactors

Refer also to abstracts 45303, 45891, 45892, and 46643.

46934 (ORNL-TM-1666) METHODS FOR CALCULATING FAST-NEUTRON LEAKAGE FROM THE SNAP-TSF REACTOR AND PRELIMINARY RESULTS. Hubner, R. S. (Oak Ridge National Lab., Tenn.). Oct. 1967. Contracts W-7405-eng-26; AT(11-1)-Gen-8. 283p. (NAA-SR-Memo-12184). Dep. CFSTI.

For Atomics International, Canoga Park, Calif.

The 05R Monte Carlo code and associated analysis codes were modified for use in the analyses of the ORNL SNAP-TSF experiments on the leakage of fast neutrons from a SNAP reactor. The reactor geometry is given in great detail. Anisotropic elastic scattering, beryllium (n,2n) reactions, and inelastic scattering processes are treated thoroughly. Importance information obtained from adjoint S_n calculations were used to construct biased distributions in 05R for the selection of source neutron parameters and of neutron track lengths between reactions. Input instructions and listings for programs and subroutines that were developed are given in the appendices; flow diagrams for certain routines are also given. Power distributions, angular leakage flux, and fluxes viewed by collimated detectors were calculated for some preliminary analyses; 05R source neutron tapes for subsequent 05R calculations on the penetration of neutrons through a SNAP-2 shield were prepared. Requirements for the final analyses are given. (auth)

46935 (SC-CR-67-2723) COMPUTATION OF OPTIMAL CONTROLS FOR A NUCLEAR ROCKET REACTOR. Price, H. J.; Mohler, R. R. (New Mexico Univ., Albuquerque. Dept. of Electrical Engineering). Sept. 1967. Contract AT(29-1)-789. 32p. Dep. CFSTI.

Various optimal reactor control problems with complicated constraints are solved for a nuclear rocket engine. The technique utilizes a digital computer with the numerical algorithm formed by a succession of linear programming problems. Each programming problem has a solution which is used to relinearize the system's dynamical equations. (auth)

Process Heat and Desalination Reactors

Refer also to abstract 45209.

46936 DUAL-PURPOSE DESALTED WATER-NUCLEAR POWER PLANT. Currier, Edwin L. (Bechtel Corp., San Francisco, Calif.); Holtom, Harold T. J. Power Div., Proc. Amer. Soc. Civil Eng., 93: 51-66(Mar. 1967).

It was shown that a nuclear-fueled combined power and desalt-

ing plant capable of producing 150 Mgal/day desalted water is technically feasible for operation in late 1971 or 1972. The proposed plant design, incorporating the Electric Utilities Group's concept and located on the Bolsa Island site, would provide 150 Mgal/day desalted water and 1629 MW (net) of electric power. The dual-purpose plant devised uses 2 nuclear steam systems to supply 2 condensing turbines and 1 back-pressure turbine. Exhaust from the back-pressure turbine supplies steam to the brine heaters. A schematic representation is shown. The 2 nuclear reactors used in the power plant design are of the commercially available, light-water-moderated-and-cooled type. To develop the physical features of plants with both pressurized water reactor (PWR) and boiling water reactor (BWR) systems, plot plans, basic flow diagrams, heat balances, equipment arrangements, and one-line electrical diagrams were prepared. The PWR and BWR systems were found to be equally acceptable from the technical standpoint and economically competitive. In either case, thermal rating of each of the 2 nuclear steam supply systems was 3000 MW. The estimated cost of producing desalted water at the Bolsa Island site was $0.219 per 1000 gal ($71 per acre-ft). The cost of Colorado River water delivered to the Diemer Filtration Plant was estimated to be $0.270 per 1000 gal ($88 per acre-ft). (BBB)

Research and Test Reactors and Critical Assemblies

Refer also to abstracts 46025, 46643, 46718, 46837, 46963, and 46964.

46937 (BAW-3647-5) PHYSICS VERIFICATION PROGRAM. PART II. Quarterly Technical Report, April–June 1967. Clark, R. H.; Baldwin, M. N. (Babcock and Wilcox Co., Lynchburg, Va.). Sept. 1967. Contracts AT(30-1)-3647; 41-2007. 27p. Dep. CFSTI.

In-core and out-of-core measurements on startup detectors for pressurized-water reactors are described. Studies of characteristics of an all-solid self-powered in-core detector in a critical assembly are discussed. Core parameters and configurations are detailed. (M.L.S.)

46938 (BNWL-501) FAST FLUX TEST FACILITY. Quarterly Progress Report, January–March 1967. Astley, E. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1967. Contract AT(45-1)-1830. 202p. Dep. CFSTI.

FAST FLUX TEST FACILITY—experiment facilities for, design of; designs for, evaluation of various; reactor core configuration for, evaluation of split wedge and conical; electrical supply systems for, schematics for external; heat removal systems for, process design conditions and construction costs for; computer simulations of, digital and analog; coolant circulation in, analog simulation of natural; structural materials for, radiation effects on; materials properties handbook for
HEAT TRANSFER—heat removal systems for FFTF, evaluation of
LOOPS—design of closed test, layout studies for
REACTOR FUEL ELEMENTS—remote handling of FFTF, evaluation of gas-cooling system for; examination facilities for, design of FFTF; thermal analysis of coolant flow blockage in FFTF; cladding for FTR, radiation effects on
REACTOR EXPERIMENTAL FACILITIES—design parameters for FFTF; heat transfer analyses for FFTF rabbit capsules
FAST TEST REACTOR—core for, parametric studies on; cooling systems for, analysis of; tube materials for, stress analysis for; core for, hot channel factor determination for; core for, radioisotope transport rate in driver
REACTOR CONTROL SYSTEMS—design for FFTF
REACTOR FUELS—radiation testing of FFTF; neutron flux and power peaking factors in FFTF, parametric analyses of; burnup effects on FFTF, safety analysis for; cladding for fast, analysis of
NEUTRONS—flux distributions in FFTF, evaluation of postulated effects of skewed
THERMOCOUPLES—time response of ungrounded, analysis of
REACTOR SAFETY—scram requirements for single channel fuel meltdown
REACTOR MODERATORS—effects on FFTF neutron physics parameters of beryllium oxide
URANIUM ISOTOPES U-238—Doppler coefficients for, effects of crystalline binding on
REACTIVITY—worths of control rods for FFTF, two-dimensional transport models for calculation of
REACTOR CONTROL ELEMENTS—reactivity worths of FFTF, two-dimensional transport models for calculation of
SHIELDING—calculations for FFTF
OXYGEN—analysis procedures for FFTF
METALS—radiation testing of liquid
NICKEL ALLOYS—radiation effects on
GAMMA SOURCES—radiation facility at FFTF, calibration of
SERPENTINE—water retention and outgassing of (M.L.S.)

46939 (BNWL-535) DRIVE SYSTEM SELECTION HTLTR OSCILLATORS. White, D. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1966. Contract AT(45-1)-1830. 30p. Dep. CFSTI.

Eleven different systems are evaluated in the selection of a powered drive system to move and control the mechanical oscillator mechanism for the High Temperature Lattice Test Reactor. The mechanism moves and positions reactor components inside the operating reactor. Objects weighing up to 1200 lbs are moved at high speeds and positioned to within tolerances of ± 0.010 in. An electrohydraulic servo drive system utilizing a servo valve was chosen as the oscillator drive. Characteristics, advantages, disadvantages, and schematic diagrams are presented and discussed. (auth)

46940 (BNWL-SA-1434) FFTF PLUTONIUM FUEL DEVELOPMENT. Hayward, B. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 29, 1967. Contract AT(45-1)-1830. 5p. (CONF-671005-3). Dep. CFSTI.

From Nuclear Metallurgy Conference, Phoenix, Ariz.

Design requirements and operating characteristics of the Pu fuel assembly of the Fast Flux Test Facility are reported. (J.C.W.)

46941 (GEAP-5543) WEIGHTED DOPPLER ANALYSIS CODE: WEDOP. Berman, D.; Wilkinson, C. D. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Aug. 1967. Contract AT(04-3)-540. 66p. Dep. CFSTI.

The computor code WEDØP was developed for the SEFOR research and development program. The objective of WEDØP is to calculate the total reactor Doppler reactivity effect in a fast reactor for: a change between two equilibrium reactor conditions or during the early portion of a fast power transient. Program input includes a detailed description of the power distribution over the reactor core, together with temperature dependent heat transfer parameters to allow the calculation of the detailed fuel temperature distribution. The local Doppler reactivity is weighted with an appropriate weighting function to obtain the total Doppler reactivity. The code does not treat transient heat transfer; hence, the calculation of the Doppler effect during a fast power transient applies only for that period during which heat transfer from the fuel rod can be neglected. The code has been used to predict the Doppler reactivity effects associated with certain experiments to be conducted at SEFOR, and to investigate analytical models for fitting experimental data. It is planned that WEDØP will be used in analyzing certain experimental data obtained from the SEFOR experimental program. (auth)

46942 (IN-1085) GRIPE II: A COMPUTER PROGRAM FOR THE ANALYSIS OF DATA FROM A PULSED-NEUTRON EXPERIMENT. Kaufman, N. C. (Idaho Nuclear Corp., Idaho Falls). Sept. 1967. Contract AT(10-1)-1230. 72p. Dep. CFSTI.

GRIPE II, written in FORTRAN IV for use on the IBM-7040 computer, is a program for the analysis of experimental data taken in pulsed-neutron experiments. It may be used for experiments in either a critical or subcritical reactor and also for data with one or two exponential decays. The program features a complete error analysis including the significant but often neglected covariance terms, X–Y plots of the data with computed curves included, and routines to detect and reduce the influence of any bias in the experimental data. A value for the reactivity of a subcritical system is calculated using both the extrapolated-area-ratio method and the Garelis–Russell method. This program is operational, a typical processing time on the IBM-7040 being 1.1 minutes for each pulsed-neutron experiment. (auth)

46943 (IN-1117) NUCLEAR TECHNOLOGY BRANCHES QUARTERLY REPORT, JANUARY 1–MARCH 31, 1967. (Idaho Nuclear Corp., Idaho Falls). Sept. 1967. Contract AT(10-1)-1230. 48p. Dep. CFSTI.

A program has been initiated to stabilize intercycle and intracycle neutron fluxes in the Engineering Test Reactor. The goal of this program is to limit the experiment neutron flux variations to ±10 percent from a standard value. A core of fuel elements containing a new combination of U-235 and boron has been tested in the ETR. The new combination of U-235 and boron was shown to reduce excess reactivity variations, thus controlling rod movement, by approximately 50 percent compared to currently used fuel elements. Seven ETRC flux runs have been made to study the effects of rod travel on power distribution in a 500-g-element

core. Results indicate that, in general, flux variations are smallest when rod movement is near the center of the 36-inch full stroke. ATR fuel plate development investigations are proceeding to establish geometric and material behavior of the plates. Comparison of the performance evaluations of Kerr-McGee U_3O_8 with ORNL U_3O_8 shows the performance characteristics of the two fuels in a matrix of aluminum to be very similar. A beam of 2 keV neutrons has been produced by transmission of a reactor beam through a Sc filter. Measurements of the change in cross section as a function of sample temperature, due to Doppler broadening of unresolved neutron resonances at 2 keV, were carried out for samples of C, Ta, and U reactor fuel. The nuclear structure of ^{178}Hf near 1 MeV excitation has been studied by observing the γ radiation emitted following resonance neutron capture. Samples of Pu-238 and Pm-147 were prepared for cross section measurements on the nuclear explosion "Persimmon". Thermal eta ratios Pu-239/U-235 and Pu-241/U-235 were determined to be 1.0232 ± 0.0078 and 1.0479 ± 0.0080, respectively. The resonance absorption integral of Np-237 was found to be 905 ± 28 barns. A study of the level structure of ^{235}U excited in α-particle decay of ^{239}Pu has been carried out. The resulting γ-ray transitions have been placed into a level scheme for ^{235}U consisting of 28 levels. Nilsson orbitals are tentatively proposed for several of the band heads. The γ radiation emitted in the decay of ^{182}Ta has been investigated using high-resolution Ge(Li) detectors. Precise values for the energies of the transitions of energy 2.09 MeV have been obtained. (auth)

46944 (IN–1120) COMPARISON OF ORNL CLEAN CRITICAL EXPERIMENTS WITH CALCULATIONS. Fox, J. K. (Idaho Nuclear Corp., Idaho Falls). Sept. 1967. Contract AT(10-1)-1230. 23p. Dep. CFSTI.

The accuracy of several reactor codes has been determined for a variety of criticality problems that are of interest in criticality safety. This was done by comparisons of the calculations with data on clean critical experiments performed at ORNL. All of the systems studied were moderated to some degree by hydrogen. Most of the comparisons are with data on highly enriched U fueled cores, although a few were with 2 to 5 percent enriched fuels. A four-group structure was used in all cases. Transport theory was used only for obtaining flux-weighted cross sections. The tabulated results indicate that with properly weighted constants eigenvalue calculations using diffusion theory agree well with experiments. 25 references. (auth)

46945 (JUL–456-RE) PROGRAMMIERTE ABBRANDBESTIMMUNG UND REAKTIVITAETSABSCHAETZUNG FUER DIE BRENNSTOFFNUTZUNG AM FORSCHUNGSREAKTOR FRJ-2 (DIDO). (Programmed Consumption Determination and Reactivity Estimation for the Fuel Utilization in the FRJ-2 Research Reactor (DIDO)). Bormann, H. J.; Muench, E. (Kernforschungsanlage, Juelich (West Germany). Zentralabteilung Forschungsreaktoren). Jan. 1967. 39p. (In German). Dep.

A method is described with which the measured flux distribution in the fuel element of the FRJ-2 (DIDO), the burnup value, reactivity changes, hot surface charge, and position velocity factors can be obtained with the help of a digital computer program (CREMAT). In addition to the explanation of the physical bases, the experimental method, and the description of the computer program, a special case is given as an example. The method can be used for all reactors which are similar in construction to the FRJ-2 and in whose core flux measurements can be made during operation. (tr-auth)

46946 (KFK–578) AN ANALYSIS OF ERRORS INVOLVED IN THE SUB-PROMPT CRITICAL TRANSIENT EXPERIMENTS IN SEFOR. Hutchins, B. A.; Ott, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Feb. 1967. 37p. Dep.

Subprompt critical transient experiments for SEFOR are discussed. A statistical error approach is used to calculate minimum permissible transients and analyze Doppler coefficient measurements. A determination of the sensitivity of the error in the Doppler coefficient due to the size of the impressed transient is made. The Doppler effect is assumed to dominate the prompt reactivity feedback. (M.L.S.)

46947 (ORNL-TM-2017) HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT, APRIL–JUNE 1967. McCord, R. V.; Corbett, B. L. (Oak Ridge National Lab., Tenn.). Sept. 27, 1967. Contract W-7405-eng-26. 18p. Dep. CFSTI.

An operations history for the HFIR for the period of April–June 1967 is given. Special fuel element irradiations are discussed. Pressurizer pump failure is summarized. Systems data are included. (M.L.S.)

46948 NEUTRON IRRADIATION CONDITIONS FOR PRODUCTION OF RADIOISOTOPES IN JRR-3. Nakamura, Haruto (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 9: 524-9(Sept. 1967). (In Japanese).

The neutron flux distribution in JRR-3 was measured, and the conditions of target irradiation are discussed for cases of routine radioisotope production. The activation method was used in the measurement of neutron flux. Gold and cobalt metal foils were used as thermal neutron monitor. Threshold detectors such as nickel and sulphur were used to measure the fast neutron flux. The maximum values of the thermal and fast neutron fluxes in the pile were $2 \times 10^{13} n/sec \cdot cm^2$ and $2 \times 10^{12} n/sec \cdot cm^2$ respectively. The epithermal neutron flux was also measured. The yields of the principal radioisotopes and the radiochemical impurities produced by side reactions were calculated. (auth)

46949 HIFAR REACTOR. Carlson, R. W. S. (Australian Atomic Energy Commission). At. Energy Aust., 10: No. 3, 11-19(July 1967).

A detailed description of the HIFAR (High-Flux Australian Reactor) is given. A cutaway drawing of a section elevation of the reactor is shown. The reactor core is detailed. Schematics for the basic heavy-water and light-water circuits are given. The control system is described. (M.L.S.)

46950 MEASUREMENTS OF TEMPERATURE AT FUEL ELEMENTS OF THE MTR TYPE IN THE GEESTHACHT RESEARCH REACTOR. Roebert, G.; Splitt, M. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht, Ger.). Kerntechnik, 9: 406-8(Sept. 1967). (In German).

By means of a fuel element of special design, the temperatures at the surfaces of the fuel-element plates were measured. At a power level of 200 kW and with convective cooling a highest temperature of 50°C was determined. At a power level of 5 MW the highest temperatures were sufficiently below the boiling point. In fuel elements positioned at the edge of the grid plate fluctuations of temperature were observed. Special attention has to be paid to the cooling of these fuel elements. (auth)

46951 CABRI: A TEST REACTOR FOR SAFETY STUDIES. Millot, Jean-Paul (Cadarache Nuclear Research Center, France). Nucl. Safety, 8: 455-61(Sept.-Oct. 1967).

The safety of swimming-pool reactors has been thoroughly studied in France. The Cabri reactor, designed for that purpose, was initially used to investigate reactivity accidents. Loss-of-coolant flow accidents were also studied, and this work is being extended with a new facility that became operational this year, Cabri Puissance. A program of fuel testing for both water and fast reactors, involving Cabri as a capsule-driver core, is being established. (20 references) (auth)

46952 ATOM RATIOS AND EFFECTIVE CROSS-SECTION RATIOS IN HIGHLY DEPLETED PLUTONIUM–ALUMINUM ALLOY FUEL. Reardon, W. A.; Christensen, D. E. (Pacific Northwest Lab., Richland, Wash.). Contract AT(45-1)-1830. Nucl. Sci. Eng., 30: 222-32(1967). (BNWL-SA-558).

The graded exposure of 4 Pu–Al alloy, 19-rod clustered fuel elements, and the subsequent destructive sampling of the elements have provided experimental data showing the variation of Pu isotopes with irradiation. Irradiations were conducted in the heavy-water-moderated and -cooled Plutonium Recycle Test Reactor. Using ^{137}Cs as a fission indicator, the depletion of the initial Pu to 50.4 ± 1.1% is determined. Reactor effective cross-section ratios for the Pu isotopes are derived from the data, and results show that the capture-to-fission cross-section ratio for $^{239}Pu(\alpha^{239})$ is 0.426 ± 0.019. (auth)

46953 DISTURBANCE OF POWER CONTROL BY ROD SHIMMING. Mosca, G.; Pizzi, P. (SORIN, Saluggia, Italy). Energ. Nucl. (Milan), 14: 598-601(Oct. 1967).

Results of measurements of control rod shadow effects in the pool-type reactor. Avogadro RS1 is presented. Ionization chamber response is shown as a function of flow rate. Effects of xenon buildup on the response of the power calibration of the compensated ion chamber channels are discussed. 8 references. (M.L.S.)

46954 SYSTEMATIC STUDY OF THE ACCURACY OF MULTIGROUP CRITICALITY CALCULATIONS FOR FAST CRITICAL ASSEMBLIES. Baker, A. R. (Atomic Energy Establishment, Winfrith, Eng.). J. Brit. Nucl. Energy Soc., 6: 249-59(July 1967).

Multigroup calculations of the effective reproduction factor (k) for 38 fast critical assemblies built on ZPR-III, Zebra and Vera are compared. For each data set, a least squares fit is made to the computed values of k, assumed to be a linear function of the atomic composition of the core. The standard deviation of the results is thus significantly reduced. The coefficients of the regression formula give clues to the sources of error in each set and show, among other things, that the success achieved by

many sets is partly due to off-setting over-reactive ^{235}U and ^{239}Pu data by under-reactive ^{238}U data. The coefficients are shown to be related to central perturbation cross-sections and hence yield quantitative estimates of the adjustments required to data to force agreement. The regression formula may also be used as an interpolation formula to correct a prediction of critical mass for an unknown system. The critical mass of ZPR-III Assembly 48 is predicted. Data on the correction necessary to diffusion theory estimates of k to obtain transport theory values in the S_4 and S-infinity approximations are given. (auth) (UK)

46955 ESTIMATION OF DILUTION RATE FACTORS FOR TRITIATED WATER VAPOUR FROM A REACTOR STACK. Soman, S. D.; Abraham, P. (Bhabha Atomic Research Center, Bombay). Health Phys., 13: 1117-21(Oct. 1967).

Tritium is present as tritiated water vapour in the effluent air from nuclear reactors using heavy water as moderator or as coolant or both. As tritium is long-lived, its estimation in air at different locations can provide a good indication of the dilution obtained at these points, if concentration in the exhaust gases is also measured simultaneously. Cold finger samples from the CIRUS exhaust system were analyzed for tritium content to estimate its rate of release. The methods adopted for the collection of samples at different locations in the Centre, estimation of tritium concentrations and the results obtained, are presented. A mains operated portable sampler was used for the collection of moisture samples from different locations. (auth) (UK)

46956 NEUTRON AND KINETIC STATISTICS OF NUCLEAR REACTORS, APPLIED TO ROSPO REACTOR. Pacilio, Nicola. Com. Naz. Energ. Nucl., Notiz., 12: No. 12, 1-9(Dec. 1966). (In Italian). (RT/FI-(66)43).

Four methods of the stochastic-probability type were studied theoretically and applied experimentally for measurement of the kinetic parameters of zero power reactors (reactivity and mean neutron life). The four methods gave consistent results of high precision. The observable parameter measured was the Rossi α in critical and non-critical systems; the parameter α_c reduces immediately to the determination of mean life and to the time of generation of neutrons and constitutes the indispensable calibration for the measurement of negative reactivity. The precision of the results obtained and the relative simplicity, rapidity, and economy of experimental procedures confirm their predominance over all other traditional methods usually adopted. (tr-auth)

46957 KERNREAKTOR-PRAKTIKUM. (Nuclear Reactor Experiments). Hoehne, Peter. Thiemig-Taschenbuecher, Band 30. Munich, Verlag Karl Thiemig KG, 1967. 125p.

A survey of reactor experiments, developed for the Siemens-MZFR, is presented. A general discussion of experiment-types is given in the Introduction. Reactivity, point distributions and spectra of reactor neutrons, radiation protection, use of the reactor as a neutron source, and use of the reactor as a measuring instrument are topics discussed in the various sections. 27 references. (M.L.S.)

46958 RE-USABLE SHIELD PLUGS FOR IRRADIATION RIGS. Uebel, R. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). 16p. (CONF-660521-5). DTIE.

From International Symposium on In-Pile Irradiation Equipment and Techniques, Harwell, Eng.

The re-usable irradiation shield plugs are developed for reuse of activated shield plugs in later experiments, reduction in requirements for high activity storage and disposal space, reduction in high activity handling, and final disposal as low activity waste. Several irradiated shield plugs have been used in the hollow fuel element facilities of HIFAR for irradiation periods up to 9,000 hours. (auth)

Production Reactors

46959 (WASH-1076, pp 87-95) TAMPER-INDICATING REACTOR SAFING SYSTEM. Fullmer, George C. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation).

An inspection system was developed to assure that production reactors shut down, presumably under international agreement, remained shut down. The feasibility of the mechanics of the inspection system was demonstrated. The safing system holding a neutron-absorbing material in the reactor consists of a safing wire, or tape, attaching hardware at the reactor faces, and a seal. Activation in a production reactor indicating production of only $^1/_{100,000}$th of a critical mass of plutonium during the exposure interval could be detected. (M.C.G.)

46960 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Wadmark, Lars Olof Tor (to Aktiebolaget Atomenergi). British Patent 1,082,187. Sept. 6, 1967. Priority date Apr. 1, 1965, Sweden.

A design is described for a water-cooled reactor in which provision is made to eliminate the possibility of condensation of steam in the superheater tubes that are in direct contact with the relatively cool moderator water and in which it is possible to exchange the fuel elements in the superheater tubes while the reactor is in operation. The superheater tube extends through the moderator tank inside an auxiliary tube having an open upper end communicating with the water space above the moderator tank in the reactor and an open lower end communicating with the water space below the moderator tank. Thus the auxiliary tubes are surrounded by comparatively hot water. (B.L.M.)

Reactor Components, Fuels and Accessories

Refer also to abstracts 45005, 45190, 45191, 45291, 45487, 45883, 45907, 45989, 45992, 46718, 46919, and 47050.

46961 (ANL-7292) METHOD FOR IDENTIFYING AND EVALUATING LINEAR DAMPING MODELS IN BEAM VIBRATIONS. Wambsganss, M. W. Jr.; Boers, B. L.; Rosenberg, G. S. (Argonne National Lab., Ill.). Apr. 1967. Contract W-31-109-eng-38. 30p. Dep. CFSTI.

The results of an effort to identify and evaluate effective linear damping models in beam vibration are presented. The study was motivated by the desire to mathematically model the dynamic response of a beam-type element in which significant energy dissipation could be attributed to the contact of the component with adjacent similar components. The usual method of modeling damping is employed, that is, assuming damping mechanisms and empirically evaluating the coefficients. The three damping mechanisms considered are designated viscous, stress, and load damping. The problem is that of identifying the dominant damping mechanism(s) for inclusion in the mathematical model, and of evaluating the associated damping coefficients. A theoretical analysis is carried out, based on the usual assumptions in (Euler) beam theory and the further assumption of the damping being sufficiently small that the natural frequencies and mode shapes are unaffected. The analysis leads to a sensitive method, compatible with results obtained from tests on a vibration exciter, for identifying the effective damping mechanisms. The technique involves a comparison of the experimentally determined ratio of first- to second-mode magnification factors, related to a common point on the beam, with the constant values of this ratio corresponding to "pure forms" of the proposed damping. The method is illustrated by application to the modeling of the response of a cluster of cantilevered beams clamped together at the base. This model is being employed in the preliminary analysis of the interaction effects of vibrating fuel rods in a nuclear-reactor core. Damping models are identified, and curves of damping coefficients as a function of cluster size are presented. (auth)

46962 (BNL-11612) SOME AEROSOL PROPERTIES OF VAPORIZED FAST REACTOR FUELS. Horn, Frederick L. (Brookhaven National Lab., Upton, N. Y.). [1967]. 3p. (CONF-671102-20). Dep. CFSTI.

From 15th Conference on Remote Systems Technology and Atom Fair, Chicago, Ill.

Fuel materials, PuO_2 and UO_2, were vaporized rapidly to simulate an accidental release of fuel during a power excursion. Individual studies were made of the nature and coagulation behavior of PuO_2 vaporized at 2800°C and UO_2 vaporized at 3000°C into both Ar and N gases, and of combinations of vaporized PuO_2-UO_2 and vaporized Na-UO_2 mixtures. (H.D.R.)

46963 (BNWL-CC-694) REACTOR FUELS AND MATERIALS DEVELOPMENT PROGRAMS FOR FUELS AND MATERIALS BRANCH OF USAEC DIVISION OF REACTOR DEVELOPMENT AND TECHNOLOGY. Quarterly Progress Report, January-March 1966. Albaugh, F. W.; Bush, S. H.; Cadwell, J. J.; deHalas, D. R.; Worlton, D. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1966. Contract AT(45-1)-1830. 223p. Dep. CFSTI.

Topics discussed include: fast fuel oxides and nitrides of plutonium and uranium; physical and mechanical properties of nuclear ceramics; nuclear graphite; basic swelling studies; radiation damage to reactor metals; ATR gas loop operation and maintenance; metallic fuels; and nondestructive electromagnetic and infrared testing. (D.C.C.)

46964 (BNWL-CC-821) REACTOR FUELS AND MATERIALS DEVELOPMENT PROGRAMS FOR FUELS AND MATERIALS

BRANCH OF USAEC DIVISION OF REACTOR DEVELOPMENT AND TECHNOLOGY. Quarterly Progress Report, July–September 1966. Albaugh, F. W.; Bush, S. H.; Cadwell, J. J.; de Halas, D. R.; Worlton, D. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Dec. 1966. Contract AT(45-1)-1830, 173p. Dep. CFSTI.

Topics discussed include: irradiation damage to reactor metals of stainless steels, nickel-base alloys, Hastelloy X-280, Inconel 600, Inconel X-750, and Zirconium alloys; ATR gas loop operation and maintenance; metallic fuel irradiation testing of thorium base alloys and uranium; and nondestructive testing. (D.C.C.)

46965 (GAMD-8119) BLOOST-6: A KINETICS CODE CONTAINING A THERMODYNAMIC MODEL OF COATED PARTICLES FOR HTGR APPLICATIONS. Dahlberg, R. C.; Merrill, M. H. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). July 19, 1967. Contract AT(04-3)-167. 24p. Dep. CFSTI.

A computer code consisting of a space-independent kinetics code, a two-dimensional time-dependent heat transfer code, and a spherical geometry time-dependent heat transfer code for fuel particles is presented. This composite program is called BLOOST 6. The code is controlled by the kinetics program which does a fourth-order Runge-Kutta integration. This integration is effected by a variable time step which is a function of change in power level. The heat transfer section of the code computes temperature distribution in RZ geometry for an average high temperature gas cooled reactor fuel element. Transient heat transfer calculations within the fuel particle include thermal conductivities of particle kernels and coatings. The bed conductivity is taken as that of the mixtures of particles and binder. Computer input for heat transfer rates, fuel region heat capacities, temperature coefficients, delayed neutron data, normalized axial power distribution, and reactivity insertion rate is tabulated. (M.L.S.)

46966 (NAA-SR-12452) SIMULATION OF REACTOR DYNAMICS. VOLUME I. A DESCRIPTION OF AIROS II-A. Blaine, R. A.; Berland, R. F. (Atomics International, Canoga Park, Calif.). Sept. 5, 1967. Contract AT(04-3)-701. 115p. Dep. CFSTI.

AIROS II-A solves the space-independent reactor kinetics equations and in addition provides for the determination of reactivity by solving the discretized equations which represent the spatial heat and mass transfer model for several fuel channels, including fuel melting, coolant boiling, and vaporization and burnout. In addition, variation of the film coefficient with flow is accounted for along with the provision for flow decay and afterglow heating. Scrams can be initiated by delayed signals from instruments which sense any quantity calculated; e.g., power, inverse period, or temperature. AIROS II-A is built of small modules or subroutines so that future modifications or additions can be made as better physical models are available. An initial temperature calculation has been incorporated for use on an input option. The input generation routine computes the conduction and convection coefficients for a nxm multichannel nodal system with built-in tables of specific heat, density, conductivity, and viscosity for the common fuel, structure, and coolant materials. Similarly, other modifications can easily be made. Up to 400 feedback equations and 15 delayed neutron equations can be solved in addition to the prompt neutron equation. The numerical method is essentially a fifth-order method with automatic time-step variation to ensure the required accuracy with the minimum expenditure of computer time. Special provisions are made for startup problems resulting in 60% reduction in running time over conventional codes. Both printed and graphical output are provided. Any 90 of the feedback variables can be printed and/or displayed. In addition, the grouping of feedbacks on each CRT frame is under the user's control. (auth)

46967 (UJV-1814) PREDLOZHENIE EKSPERIMENTA TEPLOOTDACHI U 7-STERZHNEVOGO ELEMENTA V OSEVOM POTOKE NATRIEVOGO TEPLONOSITELYA. (Experiments With 7 Rod Element Heat Transfer in Axial Flux of Sodium Coolant). Pashek, M. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). May 1967. 20p. (In Russian). Dep.

Seven-rod experimental elements for the investigation of the temperature fields and local heat transfer coefficients were constructed. The problem of reliable electrical heating of the rods of 14-mm diameter attaining a heat current of 31,900 kcal/m^2 hr was solved and the surface temperature of the rods was measured by means of microthermocouples. A mobile thermozone for the measurement of the temperature fields in the Na was proposed and described. The proposed method was verified on water. (tr-auth)

46968 NUCLEAR FUELS: STOCKS, SUPPLY, TREATMENT. Boettcher, Alfred (Kernforschungsanlage, Juelich, Ger.). At. Strom, 13: 93-7(July-Aug. 1967). (In German).

The amount occurring in nature of the fuel and breeder materials, natural U and Th, will determine the price movements of these basic materials. By reason of the heavy demand for enriched U, its purchase by economic zones which have not their own enriching plant will be an urgent problem in the field of power supplies. With progress in perfecting reactor technique, and particularly in the transition to breeders, the fuel cycle, and especially treatment of highly radioactive breeder and fuel materials, will gain in importance. (auth)

46969 TECHNOLOGY OF STEEL PRESSURE VESSELS FOR WATER-COOLED NUCLEAR REACTORS. Whitman, G. D. (Oak Ridge National Lab., Tenn.). Nucl. Safety, 8: 429-42(Sept.-Oct. 1967).

Current designs of pressurized-water-reactor vessels are based on operating conditions of 650°F and 2500 psig, and boiling-water-reactor vessels, on conditions of 575°F and 1250 psig. A Mn–Mo steel, ASTM A-533, is being used; it is satisfactory for sections up to 12 in. thick. As reactor vessels evolve and grow in size, higher strength steel alloys will be required; a Cr–Mo alloy and a Ni–Cr–Mo alloy are presently under study for this purpose. The mechanical properties of metals may deteriorate upon exposure to nuclear radiation to a degree that is of considerable engineering significance. Studies to date of such radiation damage have made a substantial contribution, but more information is required to obtain a basic understanding of the phenomena involved. The most promising candidates for the needed periodic testing and inspection of nuclear vessels for the detection of radiation and other damage appear to involve some form of acoustic phenomena, since operational requirements impede the usual techniques for inspecting nonnuclear vessels. (18 references) (auth)

46970 RADIATION DAMAGE TO PRESSURE-VESSEL STEELS. Wechsler, M. S. Nucl. Safety, 8: 461-9(Sept.-Oct. 1967).

The effects of neutron irradiation on the properties of structural materials are of significant interest to the reactor industry because of their possible relation to the integrity of reactor pressure vessels. Irradiation effects on pressure-vessel steels are considered. The variables that affect the nil conductivity transition temperature are separated into two categories — materials variables and radiation variables. Among the materials variables considered are chemical impurities, grain size, and metallurgical structure associated with welding. The radiation variables include dose, dose rate, neutron spectra, and irradiation temperature. Other areas reviewed include possible applications of fracture mechanics to the problem of radiation embrittlement in pressure-vessel steels and the effects of irradiation on the fatigue strength of steels. (117 references) (auth)

46971 HEALTH PHYSICS PROBLEMS ASSOCIATED WITH THE PRODUCTION OF EXPERIMENTAL REACTOR FUELS CONTAINING PuO_2. Fraser, D. C. (Atomic Energy Establishment, Winfrith, Eng.). Health Phys., 13: 1133-43(Oct. 1967).

Tonne quantities of reactor fuel elements containing PuO_2 mixed with varying proportions of UO_2 or other materials are manufactured in glove boxes. The PuO_2 is present initially in a finely divided form, is later incorporated into sintered pellets, and is then sealed into stainless steel cans. The chief health physics problems are very high airborne concentrations of PuO_2 which occur locally and transiently, usually as a result of damage to gloves or posting bags. The best methods of control are the avoidance of such damage by increased automation of processes, avoiding the use of sharp tools, abrasive surfaces, and by detecting damage as soon as possible by the use of well-sited air monitors or by the detection of surface contamination. Personal air samplers indicate that individual exposures in incidents are much higher than would be deduced from installed air samplers. Bioanalyses of faeces suggest that over a long period personal air samplers give a reasonable indication of personal exposure. A new fixed air sampling system is being installed at the Reactor Fuels Laboratory to give earlier warning of significant releases, and may lead to improved assessment of personal exposure without the use of personal air samplers. Levels of surface contamination have always been low. The early detection of surface contamination locally is of considerable value in indicating that a release has occurred. (auth)

46972 INDICATORS FOR NUCLEAR REACTORS. Clapp, Malcolm Donald (to Fairey Engineering Ltd.). British Patent 1,086,552. Oct. 11, 1967. Filed Dec. 17, 1963.

The design of an indicator for a nuclear reactor refueling machine is described. The two turntables forming the device comprise circular cover sections of the concrete shielding covering the reactor core and extend above the standpipes to the reactor core channel. By coordinated rotation of the turntables the charging axis of the refueling machine can be brought into alignment

with any one of the mouths leading to the fuel channels or the cooling channels. (J.C.W.)

46973 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR INSTALLATIONS. Burton, William Robert; Dickson, George Kenneth; Gittens, Gerald James (to United Kingdom Atomic Energy Authority). British Patent 1,080,794. Aug. 23, 1967. Filed May 10, 1965.

A system for purifying and recycling H_3BO_3, used in control of a heavy water cooled and/or moderated reactor, comprises bringing the B containing water in contact with a mixture of cation and strong base anion exchange resins to remove B, corrosion products and fission products, regenerating the resin with caustic alkali to remove H_3BO_3, and separating the regenerant by electro dialysis. (P.G.C.)

46974 METHOD OF CHARGING OR DISCHARGING A NUCLEAR REACTOR CORE. Dodd, John Alan; Timbs, Arthur Edward; Montgomery, Albert George; Hackett, Herman Joseph; Greer, Colin (to United Kingdom Atomic Energy Authority). British Patent 1,080,836. Aug. 23, 1967. Filed July 3, 1964.

A nuclear reactor core composed of parallel removable fuel elements within a pressure vessel is charged or discharged by a remotely controlled transfer flask containing a handling machine, a grapple capable of radial or pivotal movement, and a hoist for removal of both the transfer flask and the fuel element. (P.G.C.)

46975 IMPROVEMENTS IN AND RELATING TO CONCRETE PRESSURE VESSELS FOR NUCLEAR REACTORS. (to Sulzer Brothers Ltd.). British Patent 1,079,486. Aug. 16, 1967. Priority date May 7, 1965, Switzerland.

A concrete nuclear reactor vessel is described which comprises concrete walls and floor, prestressed after partial hardening of the concrete, and a gas-tight steel lining separated from the concrete by a space which is later filled with a flowable material capable of hardening and transmitting pressure. (P.G.C.)

46976 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Bradley, Norman; McLeish, Ronaald Douglas; Cameron, Peter John; Leigh, David Geoffrey (to United Kingdom Atomic Energy Authority). British Patent 1,081,674. Aug. 31. 1967. Filed Jan. 8, 1964.

A pressurized-water reactor consists of a core containing two groups of stainless-steel-lined Zr alloy pressure tubes housing the nuclear fuel. One group of the pressure tubes generates steam by heat exchange and the second group superheats the steam and also preheats the feed water. (P.G.C.)

46977 FLOW-LIMITING DEVICE, ESPECIALLY FOR NUCLEAR REACTORS. Costes, Didier (to Commissariat a l'Energie Atomique). British Patent 1,080,854. Aug. 23, 1967. Priority date Apr. 2, 1965, France.

Flow rate of coolant fluid in a nuclear reactor is controlled by a removable venturi tube mounted in the fuel cartridge channel. The tube is integral with a debris collector. (P.G.C.)

46978 SUPPORT STRUCTURE FOR THE PRESSURE TUBES IN A NUCLEAR REACTOR CALANDRIA TANK. Aubert, Gilles; Hassig, Jean Marc; Peuchmaur, Alphonse; Roche, Roland; Vrillon, Bernard (to Commissariat a l'Energie Atomique). British Patent 1,081,650. Aug. 31, 1967. Priority date June 3, 1965, France.

A support structure for the pressure tubes in a gas cooled, heavy water-moderated, reactor heat exchanger tank comprises an assembly of closed box elements each of which is designed to support at least one pressure tube extension. Prestressing cables which pass through the assembly and are fastened to top and bottom end beams give rigidity to the assembly. (P.G.C.)

46979 NUCLEAR REACTOR FUEL ELEMENTS. Saunders, Alan Charles Anthony (to United Kingdom Atomic Energy Authority). British Patent 1,081,874. Sept. 6, 1967. Filed July 23, 1964.

A reactor fuel element is made up of a stack of fuel members and a helical coiled spring within a closed tubular sheath. The spring is disposed between the end closure member of the sheath and the stack of fuel members. The reaction of the spring is supported solely by the sheath. (B.L.M.)

46980 FUEL CONTAINER FOR NUCLEAR REACTORS. (to Arbeitsgemeinschaft Versuchs-Reaktor (AVR), GmbH.). British Patent 1,082,706. Sept. 13, 1967. Priority date Feb. 12, 1965, Germany.

A fuel container for fissionable nuclear materials comprises a spherical body of moderator material, particularly graphite, having an inner hollow of rounded shape concentric with the outer spherical surface of the body. A rotationally symmetrical rod of moderator material is disposed in the hollow to form a ring-shaped rotationally symmetrical interspace with the body. The rod may be shaped in such a manner as to completely close off the hollow in the container. (B.L.M.)

46981 SUPPORT FOR THE CORE IN A NUCLEAR REACTOR. (to Societe Anglo-Belge Vulcain). British Patent 1,080,405. Aug. 23, 1967. Priority date Aug. 18, 1964, Luxembourg.

A support for the fuel core assemblies of a nuclear reactor is formed of a rigid frame and a perforated plate which fixes and centers the fuel assemblies and reduces head losses of coolant and/or moderator fluids. (P.G.C.)

46982 IMPROVEMENTS IN AND RELATING TO NUCLEAR FUEL CARTRIDGES. Mombazet, Rene; Raynaud, Noel (to Commissariat a l'Energie Atomique). British Patent 1,077,253. July 26, 1967. Priority date Feb. 19, 1965, France.

A reactor fuel element consists of a fuel can provided with cooling fins and discs which engage vertical slots machined in a support and in grooves in the fuel can. A sleeve surrounding and spaced from the fuel can is also grooved to receive the discs and thus lock the fuel element in place. It is specified that the sleeve, support, discs and other members may be of a material having a low neutron absorption cross-section such as graphite. (P.G.C.)

46983 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Pickman, David Openshaw (to United Kingdom Atomic Energy Authority). British Patent 1,081,764. Aug. 31, 1967. Filed Aug. 1, 1963.

A reactor fuel element comprises a bar of fissile material enclosed in a protective sheath having a number of integral longitudinal stiffening fins formed for engagement by a fuel element lifting device. (P.G.C.)

46984 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Pickman, David Openshaw (to United Kingdom Atomic Energy Authority). British Patent 1,081,765. Aug. 31, 1967. Filed Aug. 1, 1963.

A fuel element is described which comprises a bar of U metal enclosed in a sheath having cooling fins in a herringbone configuration and which is sealed by welded end closure members machined to provide bearing faces between the fuel units so that they may be stacked one upon another in a column in the core of a reactor. (P.G.C.)

46985 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Sheppard, Malcolm Frederick; Cowen, Henry Chapman (to United Kingdom Atomic Energy Authority). British Patent 1,081,701. Aug. 31, 1967. Filed July 5, 1963.

In graphite moderated CO_2 cooled reactors interaction between the moderator and coolant is inhibited by maintaining 0.5 to 10 vol % of CO in the coolant plus at least 50 ppM of a saturated hydrocarbon such as methane. Water formed by irradiation of methane is removed by conventional driers. (P.G.C.)

46986 AUTOMATIC CLOSURE DEVICE FOR ADJUSTING THE RATE OF FLOW OF GASES, ADAPTED TO AVOID DRAGGING OF NUCLEAR FUEL ELEMENTS BY THE GAS STREAM. (to SNAM S.p.A.). British Patent 1,081,188. Aug. 31, 1967. Filed June 18, 1964.

A hollow cylindrical closure, of predetermined weight, supports fuel elements in the cooling gas channel of a graphite-moderated reactor and is designed to rise in the channel and throttle gas flow as the weight of the supported fuel elements decreases, thus preventing expulsion of the fuel elements. (P.G.C.)

46987 NUCLEAR REACTOR FUEL ASSEMBLY. Hassig, Jean-Marc; Roche, Roland; Trelin, Jacques (to Commissariat a l'Energie Atomique). British Patent 1,079,307. Aug. 16, 1967. Priority date May 19, 1965, France.

Fuel cans for a reactor fuel assembly are provided with helical fins notched for insertion and locking to fins of adjacent fuel cans. The design dispenses with braces and grids which cause thermal instability and pressure drops in that the fuel cans are individually supported by their own cooling fins. (P.G.C.)

46988 IMPROVEMENTS IN AND RELATING TO THERMAL INSULATION. Armstrong, Edward; Hawgood, John (to Darchem Engineering Ltd.). British Patent 1,077,503. Aug. 2, 1967. Filed May 8, 1964.

Thermal insulation for reactor pressure vessels is provided by applying to the walls of the vessel a series of stainless steel insulating packs each consisting of fluid confining sheets spaced apart by separator members. The sheets are applied to overlap one another and render the fluid contained relatively stagnant in the area within which convection occurs. (P.G.C.)

46989 THERMAL SHIELDS FOR NUCLEAR REACTORS. Milner, Malcolm John; Richter, Heinz Alois (to The English Electric Co.). British Patent 1,078,028. Aug. 2, 1967. Filed Aug. 30, 1963.

An alloyed white cast iron thermal shield containing 0.4 to 0.8% B for absorption of thermal neutrons and minor amounts of Cr, Sn, and Va for thermal stability was developed for use in gas-cooled reactors at temperatures up to 500°C and relatively high pressures. The structure, as cast, consists of zones of pearlite surrounded by massive complex carbide with non-metallic inclusions segregated to the carbide at the interface between the carbide and pearlite. (P.G.C.)

46990 CONTROL MEANS FOR NUCLEAR REACTOR. Martin, Dudley James Victor (to United Kingdom Atomic Energy Authority). British Patent 1,080,833. Aug. 23, 1967. Filed Apr. 27, 1964.

A shutdown control for a nuclear reactor incorporates a vessel outside, and wholly or partly surrounding the core, filled with a liquid containing material of high neutron absorbing cross section, such as H_3BO_3, and valves and tubing to discharge the liquid from the reactor vessel into the neutron absorbing liquid. (P.G.C.)

46991 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Delpeyroux, Paul; Gauthron, Maurice; Pelce, Jacques (to Commissariat a l'Energie Atomique). British Patent 1,078,276. Aug. 9, 1967. Priority date Sept. 3, 1963, France.

A reactor fuel element is composed of a grooved rod of fissile material sheathed with a metal or alloy which has greater heat conductivity than the fissile material and thus improves heat transfer from the fuel rod to the outer can or sheath. Additional heat transfer is obtained by forming external fins on the cladding which contact the cooling fluid. The sheathing may be applied by immersion of the fuel in the molten metal or alloy or by spray metallizing. (P.G.C.)

46992 DISPERSION TYPE NUCLEAR REACTOR FUEL ELEMENTS. Martin, Frederick Samuel (to United Kingdom Atomic Energy Authority). British Patent 1,082,245. Sept. 6, 1967. Filed June 5, 1963.

A dispersion type fuel element consists of a dispersion of particles of UN in a matrix of sintered Al_2N_3. The UN content of the system is from 10 to 50 vol %. (B.L.M.)

46993 PROCESS FOR MAKING URANIUM MONONITRIDE NUCLEAR FUEL. Craig, Richard A. (to U. S. Atomic Energy Commission). U. S. Patent 3,345,436. Oct. 3, 1967.

A process was developed for densifying UN fuel bodies by sintering the bodies in vacuum at 1260 to 1550°C, introducing N_2 to obtain a pressure above the dissociation pressure of UN and further sintering at 2050 to 2500°C, cooling to between 1550 to 1200°C in the N_2 atmosphere, and further cooling in a vacuum. (AEC)

46994 METHOD OF HANDLING AND FABRICATING A NEUTRON RESPONSIVE FUEL. (to Atomic Energy Of Canada). British Patent 1,077,384. July 26, 1967. Priority date Sept. 9, 1964, Canada.

A method of handling and fabricating a neutron responsive reactor fuel comprises dispersion of a material of high neutron capture cross section as Cd, Gd, or Sm in the fuel ^{235}U, subjecting the fuel to neutron bombardment, by which the neutron responsive reactivity is restored in a period which is short in comparison with the life of the fuel, and a systemized procedure for insertion of the reactivated fuel rods in one of three predetermined sites in the reactor. By denaturing the re-fueling rods during processing, costs of metal storage, fabrication, shipping, and of storing fuel rods is lowered because of reduction of the criticality hazard. (P.G.C.)

46995 PROCESS FOR PREPARING NUCLEAR FUEL ELEMENTS OF DISPERSED-IN-GRAPHITE TYPE. (to Japan Atomic Energy Research Inst.). British Patent 1,078,936. Aug. 9, 1967. Priority date Nov. 5, 1963, Japan.

A dispersed-in-graphite type fuel element consisting of a matrix of impermeable graphite in which minute particles of a U compound are homogeneously dispersed is prepared by mixing uranyl nitrate hexahydrate, furfural, and phenol with a small amount of HCl, as a catalyst, and heat treating. The product shows no evidence of the existence or crystal growth of UO_2 or U_3O_8 and has improved physical and chemical properties. (P.G.C.)

46996 COMPLIANT FLANGE NUCLEAR REACTOR PRESSURE VESSEL CLOSURE. (to United States Atomic Energy Commission). British Patent 1,080,064. Aug. 23, 1967. Priority date June 7, 1965, United States.

A nuclear reactor core containment vessel is provided with a system of flexible bellows, annular seal rings, and gaskets which seal but allow entry to the top access port without the usual arrangement of bolts, dogs, and clamps. The seal is designed to conduct heat from the pressure vessel, operate at a lower temperature than the pressure vessel, and to inherently compensate for skew and uneven mating surfaces. (P.G.C.)

46997 IMPROVEMENTS IN OR RELATING TO HEAT EXCHANGERS. Wootton, William Robert (to Babcock and Wilcox Ltd.). British Patent 1,079,682. Aug 16, 1967. Filed Feb. 6, 1963.

A heat exchanger for steam boilers used in a gas-cooled reactor include a vertical pressure vessel and a casing within it, supported to allow differential thermal expansion between the casing and the pressure vessel, and containing banks of heat exchanger tubes terminating in a header. Tubular connections extend through the wall of the pressure vessel and extend from the inside to the outside of the casing without inhibiting differential expansion. Also included is a heat exchanger unit having a section of casing connected to a header means within the casing, suspension means for the header and tube bank, and connections through the casing to supports outside. Seals are provided between the connections and casing to permit movement due to differential expansion. (P.G.C.)

GENERAL

46998 (AECD/EL–6) A SEQUENCE OF PROBABILITY MEASURES ON THE EUCLIDEAN n-SPACE AND ITS LIMITS. Ahmed, Nasiruddin (Atomic Energy Centre, Dacca (Pakistan)). May 1967. 9p. Dep.

Some properties of an indexed family of probability measures $\{P_m\}$, are presented. It is shown that as m approaches infinity P_m converges to a well-defined probability measure on E^n. (auth)

46999 (AERE-PR-HPM–11) HEALTH PHYSICS AND MEDICAL DIVISION RESEARCH PROGRESS REPORT, JANUARY–DECEMBER 1966. Johnston, J. E. (ed.) (Atomic Energy Research Establishment, Harwell (England)). Mar. 1967. 61p. Dep. CFSTI. UK 8s. 0d.

Work is reported under the following headings: introduction; aerosols including natural environment, lung function studies using 5 μm particles, physics of aerosols, and the physical chemistry of aerosols; radiation physics including neutron dosimetry, personnel dosimetry, and special investigations of environmental radiation background, beta radiation and atmospheric electricity, calibration of portable gamma ray spectrometers, gamma spectrometry of the environment, output from x-ray machines, absolute standardization with liquid scintillation counters, theory of quenching in liquid scintillation counters, beta dosimetry-radiation spectrometry, and fall-out; metabolic studies including Cs, K, Ra, Sr, actinides, Fe, K, and ^{137}Cs; ^{239}Pu, Fe absorption, and other retention studies; studies on the Barwell meteorite; instrumentation including the use of computers for calculating scintillation counter background; biological measurements, including studies on the inhalation of vapors, inhalation of radioactive monodisperse aerosols, instrumentation, tritium studies, and tracer studies with irradiated asbestos; the development of analytical methods; collaboration with other organizations; and medical services including clinical pathology, radiology, and inhalation studies. A list of papers published by the Division in 1966 is included. (UK)

47000 (ANL–7324) 1620 MONITOR II-D DISK STORAGE SUBROUTINES. Krejci, Henry F. (Argonne National Lab., Ill.). Apr. 1967. Contract W-31-109-eng-38. 39p. Dep. CFSTI.

A set of subroutines is described which provides the FORTRAN user with protected permanent disk storage of data on an IBM 1620 Monitor II-D System. (auth)

47001 (BNL–11713) THERAPEUTIC STUDIES OF PARKINSONIAN PATIENTS: LONG TERM EFFECTS OF D, L, AND L DOPA. Cotzias, George C.; Papavasiliou, Paul S. (Brookhaven National Lab., Upton, N. Y.). Aug. 28, 1967. 18p. (CONF-670941–1). Dep. CFSTI.

From 2nd International Congress on Neuro-Ophthalmology and Neuro-Genetics, Montreal, Canada.

Clinical results of fairly prolonged administration of l-dopa to 12 patients with various forms of parkinsonism are reported. Results indicate that continuous oral administration of l-dopa may bring sustained relief to some patients. (C.H.)

47002 (BNL–11811) A NONLINEAR DIRICHLET PROBLEM WITH APPLICATION TO QUASI-LINEAR PROBLEMS. Lick, Dale W. (Brookhaven National Lab., Upton, N. Y.). [1967]. 7p. Dep. CFSTI.

The Dirichlet problem $\Delta u = f(u)$, $u \geq 0$, in R; and $u = \varphi\xi$, on ∂R, where Δ is the Laplacian, f is nonlinear, and φ is positive and continuous, is considered. Using results of Bers and a simple continuation technique, it is shown that the finite difference analog of this problem has a unique solution and this solution converges to the analytic solution. These results are applied to quasilinear problems with nonnegative solutions. (auth)

47003 (BNWL–485) LOOK AT SIMULATION THROUGH A STUDY ON PLANKTON POPULATION DYNAMICS. Cole, C. R. (Battelle-Northwest, Richlsnd, Wash. Pacific Northwest Lab.). Aug. 1967. Contract AT(45-1)-1830. 19p. Dep. CFSTI.

The annual cycle observed in the population dynamics of estuarine phytoplankton and zooplankton was simulated according to the model developed by Davidson and Clymer. This simulation demonstrated the usefulness of analog computer modeling in studying ecological systems. The report contains several examples in which the effect of parameter changes are predicted by the model. A typical result indicated that an increase in phytoplankton death rate increased the magnitude of the spring algal bloom. Results such as this, that contradict intuition, bring ecological mechanisms to light that might otherwise remain undiscovered. (auth)

47004 (CONF-670805–2) RATE OF POTASSIUM EXCHANGE OF GALACTOSEMIC RAT LENSES. Thoft, Richard A.; Merola, Lorenzo O.; Kinoshita, Jin H. (Harvard Univ., Boston, Mass. Howe Lab. of Ophthalmology. Massachusetts Eye and Ear Infirmary, Boston). [1965]. Contract AT(30-1)-1368. 11p. Dep. CFSTI.

From International Symposium on Eye Biochemistry, Tutzing, Germany.

Data obtained from ^{42}K uptake studies showed that there is an acceleration of K turnover in the lens of a rat fed galactose for 3 days. Even in the nuclear opaque cataracts the rate of K turnover is considerable, indicating that the cation pump mechanism is quite active. These results rule out the possibility that a defect in the cation pump mechanism is a primary cause in the initiation of this type of cataract. On the other hand, an increase in cation permeability appears to be an important factor in the development of the cataract. (C.H.)

47005 (COO–1265–44) 3100 COMPUTER SYSTEM. INTERFACE INSTRUCTION MANUAL. Hobbie, R. K. (Minnesota Univ., Minneapolis. John H. Williams Lab. of Nuclear Physics). Aug. 1966. Contract AT(11-1)-1265. 87p. Dep. CFSTI.

An instruction manual for the CDC 3100 computer system is presented. A general discussion of pulse height analyzers and computers is included, which is followed by an overall description of the system. Operating and programming procedures are presented. (W.H.K.)

47006 (COO–1543-1) THE LOAN OF GOVERNMENT-OWNED PROPERTY TO PURDUE UNIVERSITY. Period Covered: June 23, 1966–June 23, 1967. Hungerford, H. E. (Purdue Univ., Lafayette, Ind. Dept. of Nuclear Engineering). June 23, 1967. Contract AT(11-1)-1543. 16p. Dep. CFSTI.

The PUR-I reactor facility and the Nuclear Radiation Transport Research Facility at the Department of Nuclear Engineering of Purdue University are described. Appendices which present course offerings, programs of study available, and titles of recent theses accepted are included. (H.D.R.)

47007 (COO–1562-2) CANAVANINE DEATH AND THE MECHANISM OF DNA REPLICATION IN E. COLI. Technical Progress Report, August 1, 1966–August 1, 1967. Rogers, Palmer (Minnesota Univ., Minneapolis. Dept. of Microbiology). Aug. 10, 1967. Contract AT(11-1)-1562. 30p. Dep. CFSTI.

The mechanism(s) of the lethal action of L-canavanine-containing protein for Escherichia coli was investigated. It was hypothesized that the canavanyl-protein (membrane bound) disrupted the normal contact between DNA and the membrane and that this resulted in disorientation of the genome in the cell; therefore, transcription by RNA polymerase, further protein synthesis, and genome replication were blocked or prevented. Further, the canavanyl-protein prevented the attachment of new viral genomes and thus their transcription and replication. This hypothesis was supported by evidence from six lines of investigation that were as follows: the effect of canavanine on T_4 bacteriophage infection; mechanism of protein synthesis; RNA synthesis, nucleotide pools, and O_2 uptake; the incorporation of canavanine into cell protein; electron microscopy of canavanine dead cells; and an orginine-requiring canavanine resistant mutant. The results of these investigations and their relation to the hypothesis are described. (B.H.S.)

47008 (DPST–67–83–9) USAEC–AECL COOPERATIVE PROGRAM. Monthly Progress Report, September 1967. Hilborn, H. S. (comp.) (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Oct. 10, 1967. Contract AT(07-2)-1. 8p. Dep. CFSTI.

An administrative report containing no technical information is presented. (M.L.S.)

47009 (GEPP–1) CAPABILITY STUDIES OF GEXF MODIFIED HYDROSPENSERS. Creed, K. E. Jr. (General Electric Co., St. Petersburg, Fla. [Pinellas Peninsula Plant]). Sept. 18, 1961. Contract AT(29-2)-656. 48p. (R–61XF33). Dep. CFSTI.

Factory resin-mica mixing equipment, Hydrospensers, and castings were studied to determine capabilities of the equipment to deliver consistently accurate quantities of materials. Analysis of the data obtained from the various phases of this program indicate that the mixing system and Hydrospenser are capable of delivering materials accurately within a ±1 percent weight tolerance. The system is performing within these limits

at the present time. Analytical techniques appear to limit the accuracy to which the ingredients in the cured casting can be measured. (auth)

47010 (IDO-17221) TIME-DIVISION ANALOG MULTIPLIER USING AN IMPROVED FULL-WAVE MODULATOR TO MAINTAIN STATIC ACCURACY. Nielsen, J. R. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Aug. 1967. Contract AT(10-1)-205. 44p. Dep. CFSTI.

In the field of analog computers there is a need for an electronic analog multiplier which can maintain a high degree of static accuracy for long periods of time. The requirements on bandwidth are low since computer problems are usually time-scaled for display on pen recorders. A time-division multiplier that was developed using all solid-state construction is described. It maintains a static accuracy of 0.1 percent of full-scale output for long periods of time and has a usable bandwidth of 1 kHz. (auth)

47011 (IN-1116) MANUAL OF PROCEDURES FOR EFFECTING CONTROL OF SS MATERIALS AT STATION JWB. Tingey, F. H.; Lewis, B. S. (Idaho Nuclear Corp., Idaho Falls). Sept. 1967. Contract AT(10-1)-1230. 53p. Dep. CFSTI.

A procedural manual for SS materials handling at the test and research reactors at NRTS station JWB is presented. Flow diagrams for both experimental items and nuclear materials are presented. Functions of records of receipt and shipment of fuels are discussed. All records functions, consisting of discussions of AEC Forms -101, -284, and -388, are presented; internal records are discussed. Journal and ledger entries are described. Reporting of materials balance records to the appropriate AEC Operations Office is discussed. Inventory adjustments are described. Calculational methods for ^{235}U depletion from the MTR and ETR are discussed. (M.L.S.)

47012 (IS-1689) ZONE REFINING APPLIED TO A BISMUTH-TIN SYSTEM. Land, John S.; Smutz, Morton; Burnet, George (Ames Lab., Iowa). Aug. 1967. Contract W-7405-eng-82. 28p. Dep. CFSTI.

Purification of a Bi–Sn system by zone refining was investigated. The method involved the passage of a molten zone through a charge of material. Determination of a distribution coefficient by comparing experimental data to computed values was of primary interest. (auth)

47013 (IS-T-159) COULOMETRIC TITRATION OF ACIDS IN NONAQUEOUS SOLVENTS. Gainer, Frank Edward (Ames Lab., Iowa). Aug. 1967. Contract W-7405-eng-82. 91p. Dep. CFSTI.

Thesis.

Microtitrations of mineral acids, carboxylic acids, dicarboxylic acids, enols, imides, phenols, and sulfonic acids were performed in tertiary butyl alcohol and acetone solvents. These titrations were accomplished by internally generating a basic titrant by electrolytic means. A 0.1 molar quantity of polarographic grade tetrabutylammonium bromide was used as supporting electrolyte in the cathode compartments for both solvent systems. Plantinum generating electrodes were used to generate the basic species in each solvent. The hydroxide ion was generated at the platinum cathode in both the tertiary butyl alcohol and acetone solvents. The principal reactions in the cathode compartment were: $2\ H_2O + 2\ e^- \rightarrow 2\ OH^- + H_2$ $2\ OH^- + 2\ HA \rightarrow 2\ H_2O + 2A^-$. Ion-exchange membranes were used to separate the anode and cathode compartments for titrations in tertiary butyl alcohol and an ultrafine porosity glass frit served as separator of the two compartments for titrations in acetone. Tetramethylammonium bromide in methanol was used as electrolyte in the anode compartments. Both visual indicator and potentiometric end point detection methods were employed in tertiary butyl alcohol but only the potentiometric end point method was used in the acetone solvent. Benzoic acid was used as a primary standard acid. The indicator end point tended to be sharp for most compounds titrated and at most concentrations. Reasonably stable and reproducible potentials were obtained for titrations in tertiary butyl alcohol and the curves for titrations in acetone had sharp potential breaks, although not necessarily reproducible. The purity of the generated titrant was determined. This was accomplished by a volumetric titration of some of the generated base with perchloric acid in tertiary butyl alcohol and by the coulometric titration of a perchloric acid sample with generated base. The potentiometric titration curves revealed that the basic titrant was of high quality. Theories were presented to show the function of ion-exchange membranes in coulometry. (auth)

47014 (IS-T-160) PHYSICAL AND OPTICAL PROPERTIES OF CARBODIIMIDES. Mogul, Philip Harvey (Ames Lab., Iowa). Aug. 1967. Contract W-7405-eng-82. 88p. Dep. CFSTI.

Thesis.

The evidence obtained by measuring specifically selected physical parameters, such as molecular weight in solution, density, surface tension, and heat of vaporization, demonstrated that aliphatic, phenyl, and alkylphenyl carbodiimides have intermolecule potentials usually referred to as van der Waals forces. Trouton's and Guldberg's relationships further demonstrated the nearly ideal liquid state character of the carbodiimides. In addition, when the pressure–temperature information is used with the Clausius expression, equations of state of the general form $\log_{10}P = -A/T + C$ were obtained. An ultraviolet investigation of the alkyl, phenyl, and alkylphenyl carbodiimides demonstrated that absorption bands of the NCN group occur below 2000Å. A molecular complex is not observed between the aliphatic compounds and iodine in cyclohexane. Most of the characteristic alkyl group vibrational frequencies attributed to the Raman and infrared spectra of carbodiimides were accounted for without much difficulty. The $C_\alpha - N$ stretching vibrations were assigned after a thorough analysis of the 1200 to 600 cm^{-1} region and comparison with the analogous alkyl isocyanates. The C–C stretching vibration in alkyl carbodiimides follow the same behavior pattern shown by alkyl hydrocarbons, halides, isocyanates, and isothiocyanates. In addition, the NCN symmetrical stretching mode appears near 1460 cm^{-1} and is accidentally degenerate with the asymmetric methyl deformation vibration. (auth)

47015 (IS-T-183) THE CRYSTAL STRUCTURE DETERMINATIONS OF $OP(OCH_2)_3CCH_3$ AND A HYDROLYSIS PRODUCT OF $PO_4C_6H_{11}$. Nimrod, Dale Meyers (Ames Lab., Iowa). Aug. 1967. Contract W-7405-eng-82. 96p. Dep. CFSTI.

Thesis.

The crystal structure determinations of the bicyclic phosphate, $OP(OCH_2)_3CCH_3$ (1-oxo-4-methyl-2,6,7-trioxa-1-phosphabicyclo [2.2.2]octane) and of one of the isomers formed in the hydrolysis of 2,8,9-trioxa-1-phosphaadamantane, (3-α-oxo-3-β-hydrido-7-β-hydroxy-2,4-dioxa-3-phosphabicyclo[3.3.1]nonane are reported. Three dimensional x-ray diffraction counter data were obtained and refined by full matrix least-squares and Fourier techniques. Crystals of $OP(OCH_2)_3CCH_3$ were orthorhombic, space group $Pmc2_1$, with unit cell dimensions 6.74 × 5.96 × 17.77 A, four molecules per unit cell. The results suggest that some strain is probably present in the bicyclic structure. The bonding of the oxygens to the phosphorus appeared to be similar to that found in other trialkyl phosphates whose structures are known. The terminal O = P bond distance was 1.46 ± .02 A, and the bridging P–O distances averaged 1.57 ± .02 A. The O = P – O angle was 115.0 ± 1.1°, and the O–P–O angle was 103.7 ± .6°. The hydrolysis product, $PO_4C_6H_{11}$, crystallized in space group $P2_12_12_1$ with unit cell dimensions 5.84 × 11.67 × 10.91 A with four molecules per unit cell. The conformation of the isomer, predicted earlier on the basis of infrared and proton nmr spectral evidence, was fully confirmed. The conformational stability and the mechanism of the hydrolysis reaction are discussed. The tuning of a general reflection on a computer-automated x-ray diffractometer is discussed. The mathematical expressions for simplifying the mechanical movements are developed. (auth)

47016 (K-1718) DECISION TABLES FOR DOCUMENTATION AND SYSTEM ANALYSIS. Gregg, H. R. (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). Oct. 3, 1967. 21p. Dep. CFSTI.

People have difficulty both in developing and using logic, mainly due to inability of the human mind to simultaneously consider more than a few alternatives and their relationships. The logic of a problem can always be written out in sentences, but this necessitates a sequential consideration of alternative paths rather than the more desirable simultaneous consideration. The written definition may be exact, but is prone to misinterpretation and erroneous conclusions. For this reason, techniques such as flow charts, symbolic logic, and algebra are used, but again, they are primarily sequential methods of expressing logic. Decision tables are two-dimensional in nature and therefore enable us to fully express and consider both the sequential and parallel aspects of logic. This makes them uniquely suited to logic expression and development. (auth)

47017 (LA-3748) SOME DISCRETE TRANSFORMS AND THEIR CONTINUOUS ANALOGS. Nagle, D. E. (Los Alamos Scientific Lab., N. Mex.). Oct. 1, 1965. Contract W-7405-eng-36. 4p. Dep. CFSTI.

It is shown that the Cauchy, Taylor, and Laurent theorems, which refer to analytic functions, have discrete analogs which hold for arbitrary functions of the complex variable z, with the single restriction that the values of z divide the unit circle. (auth)

47018 (LA-3775) ENUMERATION OF LINEAR GRAPHS AND CONNECTED LINEAR GRAPHS UP TO P = 18 POINTS. Stein, M. L.; Stein, P. R. (Los Alamos Scientific Lab., N. Mex.). Sept. 1963. Contract W-7405-eng-36. 72p. Dep. CFSTI.

The number of linear graphs $L_{p,k}$ and connected graphs $C_{p,k}$ with p points and k lines up to and including p = 18, calculated with the MANIAC II electronic computer, is presented. Some practical aspects of the calculation and asymptotic properties of the $L_{p,k}$ are briefly discussed. (W.H.K.)

47019 (LA-DC-8786) METHOD FOR CORRECTING KNUDSEN VAPOR PRESSURES FOR CELL-VAPOR INTERACTIONS. Ward, John W. (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-36. 15p. (CONF-670935-6). Dep. CFSTI.

From 3rd International Symposium on High Temperature Technology, Pacific Grove, Calif.

A formula was derived, which allows correction of Knudsen vapor pressures for cell losses if the effusate distribution and the condensation coefficient are known. Computer and experimental studies support the validity of the formula. It is emphasized that the treatment is valid only for collimator–target experiments in which the flux from only the sample surface is analyzed. (auth)

47020 (LA-DC-8805) PRESENT STATUS OF DIFFUSE REFLECTANCE THEORY. Hecht, Harry G. (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-36. 37p. (CONF-670904-8). Dep. CFSTI.

From 154th National Meeting of the American Chemical Society, Chicago, Ill.

A review of progress in the theoretical interpretation of diffuse reflectance spectra is given. The Kubelka-Munk solution is discussed in terms of the more general theory of radiative transfer, and the layer and particle models of Johnson and Melamed are also considered. The nature of multiple scattering processes, reflectance of nonhomogeneous materials, and methods of chemical analysis are specialized topics that are discussed in some detail. (auth)

47021 (NAA-SR-12250) DETERMINATION OF OXYGEN IN SODIUM BY THE AMALGAMATION METHOD. Scarborough, J. M.; DeVries, P. F. (Atomics International, Canoga Park, Calif.). Sept. 25, 1967. Contract AT(04-3)-701. 18p. Dep. CFSTI.

Detailed analytical procedures for the determination of oxygen content in sodium by the amalgamation method are presented. The procedures are suitable for the analysis of sodium samples containing from one to ten micrograms of oxygen. Some of the problems encountered and solved in improving the method are described. (auth)

47022 (NP-17065) AUSTRALIAN ATOMIC ENERGY COMMISSION FIFTEENTH ANNUAL REPORT FOR THE YEAR ENDED 30TH JUNE 1967. (Australian Atomic Energy Commission, Coogee). Aug. 24, 1967. 107p. Dep.

Activities of the Australian AEC in the development of nuclear energy are summarized. The nuclear power plant development program, uranium raw materials production, research program, and the production and use of radioisotopes are described. (H.D.R.)

47023 (NYO-1918-148 and App. A and B) BIOLOGICAL, CHEMICAL, AND RADIOCHEMICAL STUDIES OF MARINE PLANKTON. Ketchum, Bostwick H. (ed.) (Woods Hole Oceanographic Institution, Mass.). May 1967. Contract AT(30-1)-1918. 170p. Dep. CFSTI.

Progress is reviewed of the program of studies of plankton ecology, particularly observations made in the Gulf of Maine in September 1966 on Atlantis II, Cruise 26. The plankton abundance and the nutrient chemistry of the water mass was evaluated. Statistical relationships between the observations were derived by multiple factor analysis. The appendix includes reduced data obtained on the Atlantis II, Cruise 26 to the Gulf of Maine in September 1966 and the mathematical derivation of the computer program used in the multiple factor analysis. (auth)

47024 (NYO-2038-4) PRODUCTION AND STUDY OF ASPOROGENIC MUTANTS: A STUDY OF THE FINE STRUCTURE, BIOCHEMISTRY, AND CONTROL OF BACTERIAL SPOROGENESIS. Annual Report, January 1–December 31, 1967. Lundgren, Donald G. (Syracuse Univ., N. Y. Dept. of Bacteriology and Botany). Contract AT(30-1)-2038. 80p. Dep. CFSTI.

BACTERIA — Bacillus cereus, spore formation by, effects of carbohydrate content of culture media on; Bacillus cereus, metabolism during spore formation in; Bacillus megaterium, fine structure of, during spore formation

CULTURE MEDIA — carbohydrate content of, effects of, on spore formation by Bacillus cereus (H.G.D.)

47025 (NYO-2262TA-157) THE STEEPEST ASCENT/DESCENT METHOD. Rosen, Joseph (Brown Univ., Providence, R. I. Dept. of Physics). May 1967. Contract AT(30-1)-2262. 12p. Dep. CFSTI.

The steepest ascent/descent method, a procedure for increasing or decreasing a function of more than one variable, possibly for the purpose of finding maxima or minima, is described in theory and in practice. Curve fitting is presented as an application. Various complications are discussed. (auth)

47026 (NYO-2280-26) MUTATION RATES AND MUTATIONAL LOADS IN MAN. Yearly Progress Report, September 1, 1966–August 31, 1967. Cavalli-Sforza, L. L. (Pavia Univ. (Italy). Istituto di Genetica). Sept. 1, 1967. Contract AT(30-1)-2280. 10p. Dep. CFSTI.

The research activities of the group are engaged in the description of consanguineous marriage frequency and its relevance on population structure. The reconstruction of the genealogy of a local human population is one of the aims of the group; a major effort towards this goal was developed during 1966 to 1967. The progeny of consanguineous marriages are being examined (for a limited sample of marriages) in order to estimate genetic loads using the prospective method, and data from hospitals and clinics are linked to consanguineous marriages to assess the way of transmission of the susceptibility to various diseases. The relevance of the stage of primitive culture on human evolution is also under investigation. During the first two months of 1967, about seven hundred blood samples were collected among the Babinga Pygmies of the Central African Republic. Demographic data of the Pygmy groups were also obtained, as well as reproductive histories and dermatoglyphics. The data so obtained were analyzed in part. The evolutionary meaning of imprinting was developed through the study of cases of imprinting by one or both parents. The analysis of drift in human population was continued and a new method was developed. (auth)

47027 (NYO-3699-17) INFRARED ABSORPTION OF SUBSTITUTIONAL IMPURITIES IN ALKALI HALIDES. Tak, Tseng Chu (Cornell Univ., Ithaca, N. Y.). June 1967. Contract AT(30-1)-3699. 96p. Dep. CFSTI.

Thesis.

In the study mainly low concentration cases were considered where the impurities have no internal degrees of freedom. The discussion is confined to the harmonic approximation. Lattice dynamics and symmetry properties of perfect and imperfect crystals are considered. Perfect and imperfect Green's functions, localized perturbations in imperfect crystals, and ionic impurity vibrations in alkali halide crystals are discussed. Green's functions in NaI were computed. Selection rules of infrared absorption in imperfect alkali halides are discussed and the results compared with observed data. (M.C.G.)

47028 (ORNL-TM-1818) STRUCTURE OF AMERICAN NATIONAL SECURITY ATTITUDES. Bobrow, David B.; Wilcox, Allen R. (Oak Ridge National Lab., Tenn.). Oct. 1967. Contract W-7405-eng-26. 63p. Dep. CFSTI.

47029 (ORNL-TM-1919) INDICES OF QUALITATIVE VARIATION. Wilcox, Allen R. (Oak Ridge National Lab., Tenn.). Oct. 1967. Contract W-7405-eng-26. 30p. Dep. CFSTI.

A statistical approach to analysis of public opinion on continental defense is presented. Indices of qualitative variation are developed for opinion sampling analysis. A computer program NOMSAT, for calculating the indices of variation is given. (M.L.S.)

47030 (ORO-3556-8) MYCOLOGICAL INVESTIGATIONS IN ICELAND. [PART] III. Johnson, T. W. Jr. (Duke Univ., Durham, N. C. Dept. of Botany). June 30, 1967. Contract AT(40-1)-3556. 4p. Dep. CFSTI.

A survey was made of freshwater and soil-inhabiting fungi on the south and southwest coastal plains of Iceland, and an ecological study was made on the aquatic fungi of Surtsey and its coastal waters. Soil-inhabiting fungi (Chytridiomycetes and Comycetes) were recovered from samples collected in 1965. Only those fungi that grow on cellophane, pollen, and snakeskin substrates were found. The most common representatives were in the following genera: Rhyzophydium, Rhyzophylctis, Phylctochytrium, Chytridium, Podochrytrium, Nowakowskiella, Pythium, and Aphanomyees. At least four species of Rhyzophydium were new. Among the fungi in genera of marine Ascomycetes, recovered from driftwood, were three species of Ceriosporopsis, five of Remispora, and five of Corollospora. Lulworthia medusa was common. Algal-inhabiting fungi were far less common than anticipated, although three species were collected and identified. All of the fungi found were first records for Iceland. (B.H.S.)

47031 (RLO-581-22) STUDIES OF GENETIC ALTERATIONS IN HUMAN CELLS AND MOLECULES AND THE FACTORS INFLUENCING THEM. Progress Report, August 1, 1966–

July 31, 1967. (Oregon Univ., Portland. Div. of Experimental Medicine). Contract AT(45-1)-581. 68p. Dep. CFSTI.

PHYTOHEMAGGLUTININ — molecular structure of
TISSUE EXTRACTS — separation of phytohemagglutinin from kidney bean; toxicity of kidney bean, to erythrocytes,
LYMPHOCYTES — toxicity of phytohemagglutinin to leukemic and normal, in man
DISEASES — ataxia-telangiectasia, affects of, on response of cultured lymphocytes to phytohemagglutinin
UREA — effects on mitogenicity of phytohemagglutinin in blood cells
WATER — D_2 — effects on mitogenicity of phytohemagglutinin in blood cells
CHROMOSOMES — aberrations of lymphocyte, in normal man and patients with ataxia-telangiectasia
PHYTOHEMAGGLUTININ — effects on protein synthesis in lymphocytes
HEMOGLOBIN — structure of, effects of congenital defects and blood diseases on. (C.H.)

47032 (SC-CR-67-2715) POLYFIT: A GENERALIZED LEAST SQUARES CURVE-FITTING PROGRAM. Angel, D.; Lindberg, R. C.; Vandevender, S. G. (Dikewood Corp., Albuquerque, N. Mex.). Aug. 31, 1967. Contract AT(29-1)-789. 89p. Dep. CFSTI.

For Sandia Corp., Albuquerque, N. Mex.

A computer program (POLYFIT) written in FORTRAN for the CDC 3600 for finding the best possible fit for a set of 1000 or less data points is presented. The phrase best possible fit refers to a curve of the form $Y^pX^m = a_0 + a_1X + a_2X^2 + \ldots + a_nX^n$. The order of fit may be in the range $1 \leq n \leq 11$; the range of the power of X is $0 \leq m \leq 6$; and the range of the power of Y is $1 \leq p \leq 3$. (B.G.D.)

47033 (SC-CR-67-2724) OPTICAL BACKSCATTERING FROM SINGLE WATER DROPLETS. Fahlen, T. S.; Bryant, H. C. (New Mexico Univ., Albuquerque. Dept. of Physics and Astronomy). Sept. 1967. Contract AT(29-1)-789. 35p. Dep. CFSTI.

A study was made of the two mechanisms responsible for the backscattering of light by water droplets: the axial ray and the edge ray. Using a He–Ne laser and a fiber-supported water droplet, ranging in diam from .6 to 1.5 mm, observations were made of the intensity fluctuations of these two rays as the droplet evaporated. The axial ray varies sinusoidally with droplet size parameter, and the edge ray varies in a very complicated, but periodic manner. The edge ray signal, as a function of the size parameter, appears to consist of periodic "humps" of spacing .27 ± .01, upon which are superimposed, in a coherent manner, clusters of "spikes", very narrow resonances. The basic spike period seems to be .82 ± .02. A complicated beating phenomenon appears to be present with a period of 60.7 ± 1.5. A comparison of the experimental results is made with the results of a Mie computation at 3000 in the size parameter and with a simple model. (auth)

47034 (SC-DR-67-693) HEURISTIC FOR COMPUTER-AIDED SYNTHESIS OF MULTIPLE-OUTPUT ALL NAND COMBINATIONAL-LOGIC CIRCUITS. Maschoff, L. W. (Sandia Corp., Albuquerque, N. Mex.). Oct. 1967. Contract AT(29-1)-789. 26p. Dep. CFSTI.

A heuristic for synthesis of multiple-output ALL NAND combinational-logic circuits is discussed. Results of implementing this heuristic on the time-shared SDS 930 and CDC 3600 are included. Some discussion of minimality is also included. (auth)

47035 (SC-M-67-641) PULSED VOLTAGE BREAKDOWN TESTS OF FREONS. Carpenter, N. R. (Sandia Corp., Albuquerque, N. Mex.). Sept. 1967. 19p. Dep. CFSTI.

Tests were made to determine the voltage holdoff of Freon cleaning agents and electronic grade Freons when exposed to voltage impulses of 10-μsec duration. The results, when compared to similar tests of transformer oil, show Freon cleaning agents to have less dielectric strength than transformer oil while the electronic grade Freons compare very favorably with the oil. The tests were made with four different electrodes to show the effect of the test geometry on the breakdown value. Also included are tests of Freons to which impurities have been added and tests made with assemblies in place of electrodes. (auth)

47036 (SC-R-67-1185) TABLE OF OUTPUT PROBABILITY DISTRIBUTIONS FOR A QUANTIZING ENVELOPE DETECTOR WITH A SINUSOIDAL SIGNAL IN GAUSSIAN NOISE AT THE INPUT. Edrington, T. S. (Sandia Corp., Albuquerque, N. Mex.). Sept. 1967. Contract AT(29-1)-789. 11p. Dep. CFSTI.

The quantizing envelope detector is a memory-less device with binary output: 1 if the input voltage exceeds a threshold, and 0 otherwise. This document provides probability distributions of the detector output when the input is a sinusoidal signal in Gaussian noise. (auth)

47037 (SC-RR-67-114) NEW APPROACH TO THE MICROBIOLOGICAL SAMPLING OF SURFACES: THE VACUUM PROBE SAMPLER. Dugan, V. L.; Whitfield, W. J.; Oswalt, F. W. (Sandia Corp., Albuquerque, N. Mex.); McDade, J. J. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.); Beakley, J. W. New Mexico Univ., Albuquerque). Feb. 1967. Contracts AT(29-1)-789; NASA-R-09-019-040. 47p. Dep. CFSTI.

This report describes a new approach which may be used to assay surfaces for microbial contamination. The instrument which has been developed is known as a vacuum probe and is designed for use on surfaces within ultra-clean environments, such as laminar flow clean rooms. The device is capable of providing high microbial removal efficiencies and is suited for sampling relatively large areas which possess light loading densities. The development of the test procedures necessary for the evaluation of the vacuum probe is also outlined so that the capabilities of the new surface sampler may be better understood. (auth)

47038 (SC-RR-67-650) ORTHOGONAL ARRAYS OF ODD INDEX. Blum, J. R.; Schatz, J. A. (Sandia Corp., Albuquerque, N. Mex.). Sept. 1967. Contract AT(29-1)-789. 10p. Dep. CFSTI.

A theorem establishing the existence of orthogonal matrices of odd index is proven. $M(\lambda,t)$ is defined as the maximum value of m, for given positive integers λ and t, for an $m \times \lambda 2^t$ matrix of zeros and ones with $m > t$. The inequality $m > t$ has the property that, for every choice of t rows each of the 2^t possible distinct column vectors occurs precisely λ times. Proof of the theorem is based on properties of inequalities and array properties of matrices. (M.L.S.)

47039 (SC-RR-67-742) MATCHING ALGORITHMS. Morrison, Donald R. (Sandia Corp., Albuquerque, N. Mex.). Sept. 1967. Contract AT(29-1)-789. 17p. Dep. CFSTI.

A graph M is a matching if every point is incident on exactly one line, every line on exactly two points. The following problems arise in scheduling interviews and other kinds of matchings. Given a bipartite graph B: find a matching M in B, with a maximum number of lines; find a matching M in B, which includes all the points in B whose number of incident lines is maximal; find a sequence $M_1, M_2, \ldots M_R$ of matchings in B, whose union is B and whose number is minimal. Algorithms are described to solve these and other problems efficiently. The key tools are a class of graphs called ionizations, more general than matchings and more special than bipartite graphs, and a class of transformations called improvements of the ionizations in a bipartite graph B. The matchings in an ionization and the improvements applicable to it are particularly easy to describe and to catalog. The algorithms consist of applying improvements to an ionization until no more are applicable and then extracting from the ionization the required matching. (auth)

47040 (SC-TM-67-779) RESPONSE OF AN ELASTIC MEDIUM TO A MOVING SHEAR LOAD. Rogge, T. R. (Sandia Corp., Albuquerque, N. Mex.). Oct. 1967. Contract AT(29-1)-789. 25p. Dep. CFSTI.

An analysis is presented which gives the nontransient, steady-state solution for both a half space and an infinite slab when subjected to a moving shear load. The solutions show the wave propagation characteristics of these problems. (auth)

47041 (SCL-DR-67-81) MEASUREMENT CAPABILITIES OF THE SANDIA CORPORATION, LIVERMORE LABORATORY, STANDARDS LABORATORIES. Wilson, J. L. (Sandia Corp., Livermore, Calif.). Oct. 1967. Contract AT(29-1)-789. 26p. Dep. CFSTI.

The principal measurement services provided by the Livermore Laboratory Standards Laboratories are summarized, and the nominal levels of measurement accuracy that can be obtained are listed. (auth)

47042 (TID-23948) A STRUCTURAL ANALYSIS OF THE ALPHA CRYSTALLINS OF THE BOVINE LENS CORTEX. Palmer, Winifred G. (Connecticut Univ., Storrs). 1967. 42p. Dep. CFSTI.

Thesis.

Alpha crystallins were resolved into five distinct proteins by the use of DEAE chromatography and differences between these proteins were demonstrated. Experiments were conducted on the dissociation of alpha crystallins by treatment with sodium dodecyl sulfate. Tables and graphs are presented to show results of experiments involving column chromatography, sedimentation

studies, electrophoresis, recombination experiments, immunochemical analyses, peptide analysis, and urea analyses. (H.L.W.)

47043 (TID-24051) OSCILLATORY BEHAVIOR OF SOLUTIONS OF LINEAR ORDINARY DIFFERENTIAL EQUATIONS OF THIRD ORDER. Dolan, J. Michael (Tennessee Univ., Knoxville). Aug. 1967. 147p. Dep. CFSTI.

Thesis.

The oscillatory behavior of solutions of the canonical third-order linear differential equation $L_3(y) = \{\gamma_2[(\gamma_1 y')' + q_1 y]\}' + q_2(\gamma_1 y') = 0$ on an interval I where γ_i, q_i belongs to C(I) and $\gamma_i > 0$ on I, i = 1, 2 is investigated. Qualitative theories of first extremal points, conjugate points, and focal points of the equation are developed. (W.H.K.)

47044 (UCID-15208) THE ANALYSIS OF 1,3,5,7-TETRANITRO-1,3,5,7-TETRAZACYCLOOCTANE (HMX) AND POTASSIUM PERCHLORATE IN PLASTIC-BONDED EXPLOSIVES. Selig, Walter (California Univ., Livermore. Lawrence Radiation Lab.). Sept. 14, 1967. Contract W-7405-eng-48. 9p. Dep. CFSTI.

Methods are presented for the analysis of plastic-bonded explosives containing HMX, potassium perchlorate, and polyethylene or Viton binders. The plastic was extracted from the polyethylene-bonded explosive with carbon tetrachloride. Potassium perchlorate was reduced in 1 : 2 sulfuric acid with titantium hydride and the resulting chloride was determined argentimetrically. HMX may be calculated by difference or determined in a separate sample by titration with potassium hydroxide in demethylsulfoxide solution. In the Viton-bonded explosive, the plastic was analyzed by extraction of HMX and potassium perchlorate with concentrated nitric acid. HMX was determined by an infrared method based on the absorption of the nitro group at 1565 cm^{-1} in γ-butyrolactone. Potassium perchlorate was calculated by difference. (auth)

47045 (UCRL-13312) STUDY OF A POSITION-CLASSIFICATION COMPUTER. Final Report. Luisi, James A. (Autonetics, Anaheim, Calif.). Aug. 25, 1967. Contract W-7405-eng-48. 70p. Dep. CFSTI.

For California Univ., Livermore. Lawrence Radiation Lab.

The selection of memory hardware for a position-classification computer is discussed. The computer operates on measurements from inertial instruments to perform navigation-computations. The computer must then classify the resulting position-coordinates with respect to a stored map. A combination of Read/Write and Read Only memory was recommended to reduce size, power-dissipation and cost. (auth)

47046 (UCRL-13315) PROCESS STUDIES ON FEFO. Final Report. Report No. 3466. Marcus, H. J.; Miller, F. E.; Rindone, R. R. (Aerojet-General Corp., Azusa, Calif.). Oct. 1967. Contract W-7405-eng-48. 83p. Dep. CFSTI.

For Univ. of California Lawrence Radiation Lab., Livermore.

The results of investigations into the methods of preparation of FEFO [bis(2-fluoro-2,2-dinitroethyl)formal] and its intermediates, and the associated analytical methods are described. (auth)

47047 (UCRL-17820) DIFFERENTIAL THERMAL CALORIMETRIC DETERMINATION OF THE THERMODYNAMIC PROPERTIES OF KAOLINITE. Nicholson, Patrick Stephen (California Univ., Berkeley. Lawrence Radiation Lab.). Sept. 1967. Contract W-7405-eng-48. 53p. Dep. CFSTI.

Thesis.

A differential thermal calorimeter was calibrated by measuring the heat content of SiO_2(quartz) and α-Al_2O_3 between room temperature and 1100°C. The results were compared with accepted literature values and agreement to ±2% observed. Differential thermal calorimetric values of 305,250 and 280 cals/mole for the $\alpha \rightarrow \beta$ quartz inversion also compared favorably with the accepted 290 cals/mole. Having demonstrated the accuracy of the instrument, thermodynamic property estimations were undertaken on kaolinite. (auth)

47048 (UCRL-50320) INSTRUCTION MANUAL LC-4 OSCILLOSCOPE CAMERA. Niemi, O. W. (California Univ., Livermore. Lawrence Radiation Lab.). July 1967. Contract W-7405-eng-48. 64p. Dep. CFSTI.

The instruction manual describes the Model LC-4 35 Oscilloscope Camera System, its purpose, function, and design environment; and the procedures for installing, operating, and maintaining the camera system. The manual is divided in the following parts: the basic camera (required accessories, parts breakdown, and their use and maintenance), rapid film back, cut film back, and 35 mm modular film back. (auth)

47049 (UUIP-493) DISLOCATION STRUCTURE OF AN AUSTENITIC STAINLESS STEEL IN DIFFERENT STAGES OF FATIGUE. Vingsbo, O.; Lagerberg, G.; Hansson, B.; Bergstroem, Y. (Uppsala Univ. (Sweden). Inst. of Physics). Aug. 1966. 34p. Dep.

The dislocation structure in austenitic stainless steels at different stages of fatigue were studied by means of transmission electron microscopy. For stress amplitudes well below the endurance limit (defined as the stress amplitude giving fracture beyond 10^7 cycles) a structure of randomly distributed slips dislocations of low density was built up and remained unchanged from 10^4 cycles. At the end of the lifetime of specimens fatigued above the endurance limit, the dislocations occurred in dense tangles, which frequently were arranged in cell walls. The tangles were clustered with dislocation loops elongated in a (211) direction. Also parallel rows of elongated loops were observed. Stocking fault tetrahedrons of an irregular distribution were found. The stacking fault energy of the material was estimated from the edge length of the largest observed tetrahedrons. A complementary experiment indicated that stacking fault tetrahedrons in the present materials are not of vacancy origin. A detailed study shows that stacking fault tetrahedrons as well as the observed elongated loops may be formed by a dislocation mechanism. This mechanism includes the process of screw dislocation cross slip, and it is suggested that cross slip in stainless steel during cyclic loading is possible also at moderate stresses. A dislocation mechanism for crack nucleation involving the formation of crystal voids from strings of intrinsic prismatic dislocation loops is proposed. (auth)

47050 (WASH-1076) PROCEEDINGS OF THE SYMPOSIUM ON SAFEGUARDS RESEARCH AND DEVELOPMENT HELD AT ARGONNE NATIONAL LABORATORY, JUNE 26, 1967. (Argonne National Lab., Ill.). 175p. (CONF-670613). Dep. CFSTI.

Papers presented at the symposium are included and separate abstracts were prepared for 12. New problems in safeguarding the atom, background of internation safeguards, arms control implications of safeguards, and organizational changes within the AEC affecting safeguards are also discussed. One paper was previously abstracted for NSA and appeared as 21: 30655. (M.C.G.)

For abstracts of individual papers see: 45016–45021, 45213, 45627, 45628, 46865, 46866, and 46959.

47051 (Y-1588) MACHINE TOOL EVALUATION STUDIES. Oakwood, J. S. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Oct. 17, 1967. Contract W-7405-eng-26. 46p. Dep. CFSTI.

A series of tests has been performed to evaluate specific machine-tool characteristics. Empirical data pertaining to horizontal turning machine spindles were collected under normal shop conditions. Some conclusions have been inferred from the data presented. It is the primary purpose of this report, however, to focus attention upon the present state of the art with respect to machine-tool capability. (auth)

47052 (Y-1594) AUTOMATIC CENTERING INSPECTION MACHINE. Feezell, Rasey R. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Oct. 13, 1967. Contract W-7405-eng-26. 96p. Dep. CFSTI.

The inspection of accurately machined parts which are surfaces of revolution requires the part to be placed precisely in the center of a rotary inspection machine. This is normally done manually, requiring considerable time and an experienced inspector. A two-axis, sampling-type control system has been designed to perform this operation automatically without the use of skilled operators. The ultimate centering accuracy is limited by the mechanical performance of the inspection machine. Specifically, the accuracy is limited by the backlash and free play of the cross slides on this particular machine. Two design-aiding computer programs are also reported. (auth)

47053 (LA-tr-67-90) RESEARCH ON LOW MOLECULAR WEIGHT RIBONUCLEIC RIBOSOMIC ACID ISOLATED FROM MAMMALS. Galibert, F.; Larsen, Ch. J.; Lelong, J. C.; Boiron, M. Translated for Los Alamos Scientific Lab., N. Mex., from Bull. Soc. Chim. Biol., 48: 21-35(1966). 19p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

A RNA of low molecular weight with a sedimentation constant near 5S was isolated from ribosomes of KB and liver cells of the rat. This RNA displays many chemical and biological properties markedly different from those of other cellular RNAs already known and cannot be mistaken for any one among them or among their degradation products. Various hypotheses concerning its biological role are suggested. (auth)

47054 NUCLEAR TRAINING AT ONTARIO HYDRO. Howey, George R. (Ontario Hydro, Rolphton). Power Eng., 71: 46-50(May 1967).

A training program for personnel operating nuclear power

plants is outlined in conjunction with a description of the Canadian 20-MW Nuclear Power Demonstration (NPD) plant in which the training center is located. The NPD plant was built under a partnership arrangement among Ontario Hydro, Canadian General Electric Co., and Atomic Energy of Canada, Ltd. A station staff chart shows current positions in nuclear stations. The training program supplies trained men for these positions. Complement for each position is indicated, and functions of the major positions are described. The training course consists of 9 topics, and each is subdivided into subjects. These subjects are taught by individual lessons. The first 2 topics orient the trainee and teach him about station management. Topics 2 and 3 relate to theory, and application of theory for understanding nuclear station equipment. Topic 4 is skill training of operators and maintainers, and topics 5 and 6 cover particular station training. There are 330 station field checkouts which the operator must complete to become control room operator, requiring about 4 yr. Topic 8, on radioprotection, includes 150 hr of training, and topic 9 is personal development. The Atomic Control Board of Canada reviews training methods and courses, and sets its own qualifying examinations for supervisors. The health physics laboratory, with various types of monitoring equipment and radiation sources, permits radiation experiments. Training is provided for outside organizations interested in, or using, the pressure-tube type of reactor, water cooled and moderated, using natural uranium oxide as the fuel. (BBB)

47055 SOURCEBOOK ON ATOMIC ENERGY. Third Edition. Glasstone, Samuel. Princeton, N. J., D. Van Nostrand Co., Inc., 1967. 883p. $9.25.

Beginning with the foundations of atomic theory, electricity and matter, energy and radiation, and the structure of the atom, the growth of thought and knowledge in such fields as natural radioactivity, detection and measurement of nuclear radiations, acceleration of charged particles, nuclear reactions and artificial radioactivity, the neutron, nuclear forces, and nuclear fission are discussed. The sections on the utilization of nuclear energy, reactors, synthetic elements, uses of isotopes and radiations, biological effects and radiation protection, cosmic radiation, and elementary particles were expanded based on recent developments in these areas. (B.G.D.)